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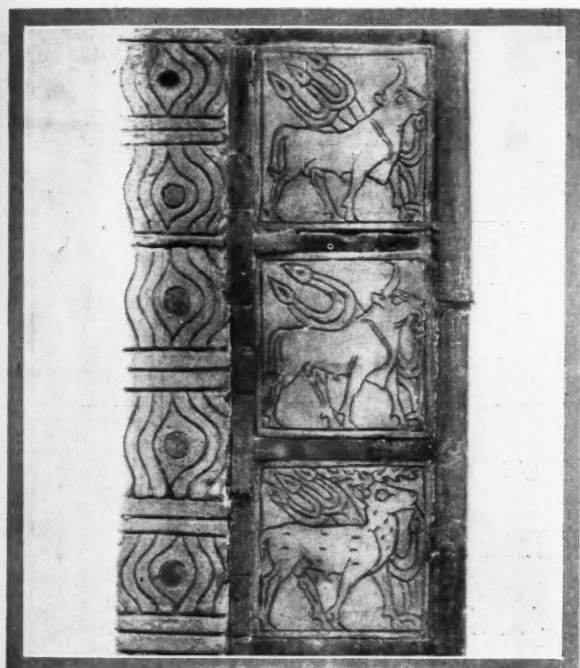
# DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. VIII, No. 90.

JUNE, 1927.

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Vol. VIII. No. 90. JUNE, 1927.

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## Editorial Notes.

THIS month we are able to issue an invitation to *Discovery* readers and their friends to visit places of interest in the neighbourhood of Fleet Street where our offices are situated, in the centre of the historic square mile which constitutes the City of London. Bouverie House rests upon the site where Dr. Johnson laboured, and from our windows can be seen the low-roofed garrett adjoining, where the Dictionary was compiled; between the Law Courts on the west and the Mansion House to the east, it is surrounded with monuments of literary interest. It is something of a reflection upon us as a people that while we are prepared to make laborious journeys for the artistic attractions of Paris, or Brussels, or Rome, we do not bother to acquaint ourselves with our own national treasures, many of which, at our very doorstep, vie in world-wide interest with anything to be found abroad. For the enjoyment of readers of the several journals published by Benn Brothers, therefore, a series of weekly lecture tours has been arranged, to begin on Tuesday, 21st June. Under the guidance of Mr. Allen Walker, who is well known as an authority on the antiquities of the City, and is extension lecturer to the University of London, the party on that afternoon will be conducted through the Temple, while on Wednesday, 29th June, St. Clement Danes and the "Old Curiosity Shop"—No. 17 Fleet Street, which escaped the fire of 1666—will be visited. The remains of Bridewell Palace and the Record Office Museum are included in the programmes for 5th and 13th July, such tours

having been arranged for Tuesday in one week, and Wednesday in the next, throughout the summer. It is proposed that the party will assemble in Bouverie House at 2.45 p.m., returning after the tour for a cup of tea at 5.30 p.m. While no charge whatever will be made, readers should apply to the Editor of *Discovery* for tickets at least a fortnight prior to their intended visit, as the number on each date must necessarily be limited to a party of convenient size.

\* \* \* \* \*

In his speech at the Colonial Office Conference held in London last month, Mr. Amery urged at some length the need for fuller co-operation in research throughout the Empire. While we have immense resources which science alone can bring to rapid development, it is obvious, he said, that we need a wider outlook and some more effective system of interchange than we have at present, if the right men are to be attracted to such research as a career—using the term, in the words of the Colonial Secretary, "not so much necessarily as regards salary as in the sense of a field of work wide and varied enough to call the best out of each man." It was therefore a happy coincidence that in answer to a question in Parliament a few days later, Lord Balfour was able to give some practical instances of problems that were now the subject of official research, which had hitherto been comparatively neglected. In the matter, for instance, of the Empire supply of quinine, now under investigation, it was pointed out that hitherto this had been derived almost entirely from the Dutch dependencies, yet there was no reason why this absolutely essential drug should not be cultivated elsewhere.

\* \* \* \* \*

Another Imperial problem mentioned in this connexion by Lord Balfour was the tsetse fly. Experiments which are being made to control this pest in Northern Nigeria were recently described by the Lagos correspondent of *The Times*. The tsetse comprise the game-feeding bush species and the riverine type, the former particularly inhibiting

the keeping of cattle and horses and the latter being specially harmful as the carriers of sleeping sickness. In the wetter southern portion of the country the war against tsetse has to be confined at present to local measures the clearing of important river crossings and the neighbourhood of settlements. In the northern part the relatively small area of the infested country makes it possible to go beyond this and to attempt definite reclamation of the land, and it is upon this problem that the tsetse investigators in Northern Nigeria are mainly concentrating. The methods under experiment include destruction by grass fires and forest clearing, but the most interesting is the exclusion of wild game by means of wire-netting fences from a well-defined fly centre. As the result a thriving colony of tsetse which used to exist for the greater part of the year about the enclosed pool is now reduced to a few hungry stragglers from neighbouring fly centres. The fact that this species would disappear with the game is therefore proved and, while wholesale game extermination is not advocated, the view is held that no effort whatever should be made to preserve the antelope. With the pig, this animal is the only important source from which the tsetse derives the virus that destroys domestic stock, and it must be prevented from spreading in the cattle country.

\* \* \* \* \*

The discussion now in progress on the future of flying, of which a letter we publish this month from Admiral Henderson is typical, gives an added novelty to a new project for the construction of a rocket "space-ship." When so many problems concerning the aeroplane have yet to be solved, it is refreshing to find a German aviator expressing an almost bored dissatisfaction with the records so far attained, and proceeding to investigate the possibility of flying in space, outside the region in which the gravitational attraction of the earth is operative. The article by Herr Valier on another page, indicates quite clearly that he is approaching the problem on scientific lines—an important consideration in view of the wild schemes proposed from time to time, usually with no more serious principle behind them than to "blow something off" and "see what happens." On the other hand, it should be pointed out that we have printed this author's views, not because his proposition should be judged as practical politics of the moment, but rather as opening up possibilities, in a field which has as yet been the subject of little serious research.

\* \* \* \* \*

The preliminary programme has now been issued of the British Association meeting to be held in Leeds

from 31st August to 7th September. Keen as is its concern for the advancement of science, the British Association has never been unmindful or contemptuous of the fruits of science reaped by civilization through industry and commerce, and among the populous industrial centres of the country and the Empire the town of Leeds has been visited twice before. At the moment when we celebrate the achievement of direct speech by wireless across the Atlantic, it is of interest to recall that on the first occasion, in 1858, it was announced that a telegraphic cable had been successfully laid between England and America, and the first messages of goodwill between the nations had passed only a few days before. Members attending this year's meeting will have access to many of the great factories and workshops of the district, while attractive excursions have been arranged to the famous abbeys and castle ruins of the Yorkshire dales.

\* \* \* \* \*

Little more than a year ago, when the usual advance particulars of the British Association meeting were made public, considerable opposition was raised in the daily press at the proposal to admit Germans as members again, in particular on an occasion which was to be marked by a Royal presidency. Since that regrettable outburst, however, there has been a steadily increasing tendency once more to relegate national considerations to a second place where cultural matters are concerned, and the latest evidence of this is contained in the announcement of a proposed new edition of the Greek Testament. In a letter published last month over the signatures of the Bishop of Gloucester, Sir Frederic Kenyon, Professor Burkitt, and other distinguished scholars, it was pointed out that more than fifty years have elapsed since Professor Tischendorf's famous edition came out, since when much has been accomplished. New manuscripts have been discovered and versions edited, and although the material available is at present very great, no satisfactory collection or synopsis of it has yet been made. It is therefore proposed that this should now be done. As the work will require the co-operation of many scholars and the examination of manuscripts in various parts of the world, committees have been formed not only in this country but in Germany and America. It is hoped that similar bodies will be set up in France, and perhaps in Italy, for a task which will be interconfessional as well as international. Its cost is estimated at £5,000, and funds for an enterprise which—to quote the announcement—"should appeal to all those who value the Bible," will be welcomed by the Dean of Christ Church, Oxford, who is acting as treasurer.



## The New Excavations at Ur, 1926-27.

By M. E. L. Mallowan, B.A.

*As a member of the expedition conducted by Mr. Leonard Woolley, the author gives a first-hand account of the past season's discoveries at Ur. The photographs have just reached this country from Mesopotamia, and are reproduced by courtesy of the Trustees of the British Museum and the Museum of the University of Pennsylvania, who have undertaken joint excavations on this site.*

Of all the ancient city sites of Mesopotamia, Ur of the Chaldees, familiar to us from the Book of Genesis as the home of Abraham, has proved itself among the most fertile. For five continuous seasons it has yielded its treasures to the well-directed spade of the Arab workman. Nor is it only the rich profusion of material objects, the works in stone and metal, the inscriptions upon clay that have so far widened the historical horizon of the student of Mesopotamian archaeology; but a wealth of architectural remains has given the architect ample data for the reconstruction upon paper of the ancient temples and dwelling-houses of the people. Last season reproduced the uninterrupted run of success. The archaeologist, the epigraphist, the architect and the anthropologist alike, found in the rich and varied sources of the work fresh information from which they could speed on their combined task of adding new chapters to a long-forgotten history.

In November, 1926, Mr. C. Leonard Woolley, the director of the expedition, decided to dig up a portion of the city proper that abutted on the south-west side of the Temenos wall—the sacred enceinte of the city enclosing the temple area. Ancient Mesopotamia, like ancient Greece, was a kingdom of city states, and just as the ancient Greeks, wary against attack, set their temples and temple treasures upon an acropolis, so too the men of Ur fenced a mighty wall around the sanctuaries that they erected to their gods, and set the dwellings of the layman outside the Temenos. Deserting the temple area then, we set to work at the surrounding city. Immediately below the surface were scanty remains of the Persian

period, but these were not our quest. As we went down so we laid bare the works of Nebuchadnezzar, of the early Assyrians, of the Kassites, the deeper we dug the richer the soil, until we arrived at our objective some twenty feet below the surface. This was the city that flourished in the time of Abraham.

The area uncovered measured roughly one hundred by fifty yards. A month's work sufficed to dig clear sixteen houses and to excavate the length of five streets. A modern visitor sauntering down the main thoroughfares and calling in at the deserted houses would quickly form the impression that their one-time owners were

men of dignity and position. And rightly so, for though on the whole small and compact these houses are built of bricks, burnt or crude, of the finest quality. Their vicinity, the character of the objects found in the rooms, and the type of literature all indicate a district inhabited by leading business men and officials. One or two of the foremost inhabitants had obtained bricks with the name of the reigning king from the royal brick contractors, and had placed them in prominent positions in the pavement. In more than one house we obtained the name of King Libit Ishtar, who flourished in 2100 B.C. Further literary evidence and that of pottery which every day becomes a more valuable canon of periods for Mesopotamian archaeology, showed that the town was ruined in about 1900 B.C. under the First Babylonian dynasty.

The houses, though differing in size and particulars, were all very much of a type. Even to-day but little would be required to make them habitable. Often



COURTYARD OF A PRIVATE HOUSE OF 2100 B.C.

Four pots and a wooden column base are seen in position as found, while on the right is the staircase leading to an upper floor. This is the first occasion that houses of the time of Abraham have been discovered.

enough the room walls still stand some fifteen or sixteen feet high, the pavement is intact, and the brick stove in the kitchen only awaits fuel for the fire. The stone quern is in the storeroom and the flower-pots remain upon the courtyard floor. Entering by the front door one passes the porter's lodge into the court from which radiate the liwan or reception room, the kitchen and the storerooms. In the court of a typical house was found the base of one of the four wooden columns that must have supported the triple wooden balcony which gave access to the rooms upon the upper floor. Unfortunately, the upper floors have all fallen in, but the staircases leading up to them are often preserved with the lavatory conveniently situated beneath, a feature of house-planning common enough in our own period. Every house contained some feature of special interest. Straightened circumstances had compelled the tenant of one to build a partition wall across the back of his house to enable him to let to strangers. The more prosperous owner of another had extended one side of his dwelling and turned what had once been a public lane into his backyard. Beneath the floor of this same yard he buried his relations. Nothing is more striking than this practice of burying the family beneath the floor of the house. Sometimes in clay coffins, sometimes in clay pots, sometimes in corbel or barrel-vaulted brick graves, every house yielded its dead from beneath the floor—relics of a pious but insanitary custom. On pulling up the pavement of one house we found stored in clay pots the skeletons of over thirty children. The occupant of this house was a man of culture and learning, for we found adjoining the chapel which contained the children's graves a rich and varied library. Here were hymns, king lists, dictionaries, mathematical tables with lists of square roots and in general works that would have been useful to a schoolmaster. But this quarter of the town met eventually with disaster. The same fire that destroyed the richest temple of the moon goddess Nin Gal destroyed the houses too. The soldiers of Babylon, jealous of the independent south,

sacked the city and killed the keepers of its shrines. So severe was the damage that when the next builders came—the Sassanids, two centuries later on—no attempt was made at restoration. The ruins were filled in and new houses were erected upon the earth that buried the old.

As we glance down the long narrow streets with their curious corners rounded off to prevent the beasts of burden from grazing themselves as they turn, we are struck by the analogies of the ancient with the modern. The dwelling-house of to-day in Baghdad is an exact replica of its ancestor of five thousand years ago. The length and narrowness of the streets,

the thickness of the walls, all designed to keep off the rays of the torrid sun, show that the inhabitant of Mesopotamia found a solution to the problems presented by his climate at a very early date. The inhabitant of Babylonia of to-day makes use of the same solutions that his far forerunners discovered for him.

By the time that we decided to cease digging at this site we could be well satisfied with its contribution to history. For the first time there

had been established a consistent town plan of 2000 B.C. Here Abraham may have walked; indeed there is nothing absurd in supposing that he may once have been a tenant in this wealthy district. The similarity of construction between temple and private house, a similarity already revealed by the Germans at Babylon for the period of Nebuchadnezzar, has at Ur been proven for a period 1400 years earlier. Lastly, the discovery of a fallen archway at the back of one of the houses exactly in position on the floor as it fell carries back the history of the arch in Mesopotamia by seven hundred years.

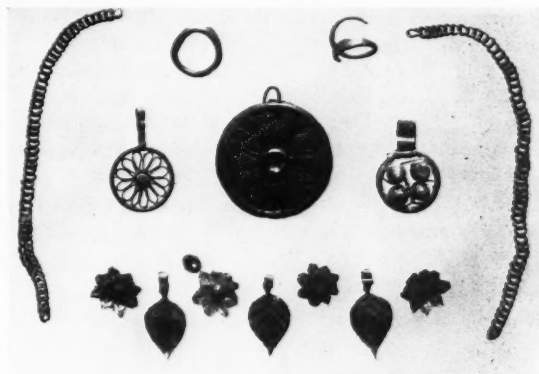
Following on the work at the town site excavations were carried on in three places simultaneously, and interesting results were forthcoming in every case. First we followed along the Temenos wall at a point where the line had been lost when it was first discovered. The second venture met with success, for we lighted upon what must undoubtedly have been the royal entrance to the Temenos. This was



EXCAVATORS AT WORK IN THE CEN  
Some of the most valuable discoveries of the season were made on this site, where one hundred and fifty men were employed in digging.

a double gateway, an inner and an outer, each entrance being about two metres wide. The approach to the outer gate consisted of a great courtyard about forty yards across, admitting the royal road by which the king would make his triumphal entrance to the sacred heart of the city. This was the work of Nebuchadnezzar, who doubtless thought that the ancient capital of southern Mesopotamia should be dignified with a worthy entrance even if it were not as imposing as the great processional road to Babylon itself.

The second undertaking was the pulling up of the pavement of Nebuchadnezzar in the temple of E-nun-Makh, the temple of the moon god excavated five years ago. Here were found the inscribed diorite door sockets of a Kassite King of Babylon, Marduk Nadin-Ahe, who in about 1100 B.C. had evidently wished to enhance Babylonian prestige in the south at a time when his city was on the decline. He therefore extended his patronage to the temple of the moon god at Ur. Very precious was the lady's ivory toilet set found under the same pavement. This consisted of a round box lid, a mirror handle, a paint-box in the shape of a sphinx, and two ivory combs, upon one of which there is engraved a bull in the act of tossing its head, a beautiful artistic composition brimming with life and vigour. Only a lady of great distinction could have boasted so fine a toilet set. Curious, too, was the ivory of an ivory casket lid that bore a Phoenician inscription telling of its dedication by a lady to Ishtar. Only on two or three occasions have Phoenician inscriptions



GOLD JEWELLERY FROM EARLY GRAVES.

An amazing profusion of such ornaments was found at Ur, commonest among them being ear-rings (3200-3500 B.C.).

been found at Ur, but this and the objects found with it are additional proofs that Phoenician products had penetrated to cities so remote.

Concurrently with the other two sites we excavated a building situated on the outskirts of Ur a mile away from the temple enclosure. This was a heavily buttressed burnt-brick building erected shortly before 2000 B.C. by King Sin-Iddinam. Only one end of it, and that a long and narrow hall, remained. Brick inscriptions indicate that it was built in honour of his dead father—possibly a mortuary chapel—but the real interest of the building lies in the fact that it must have had a vaulted roof. That it had a vault is beyond doubt, not only because of the extreme and otherwise unnecessary thickness of the walls, but because of the existence of two great piers in the shape of a Greek cross whose purpose can only have been to serve as a base for vaulting. A variety of other considerations and the fact that barrel-vaulted tombs were already known at this period, gives certainty to the conclusion that the building had a vault. This is a discovery that forces us to make a startling revision of our canon of periods for the ancient architecture of Mesopotamia.

For the last two and a half months of the season our three divisions joined forces once more, and the entire body of one hundred and fifty men was employed in digging the one untried area of the Temenos, the south-east end. Here we discovered the most ancient cemetery of Ur. Immediately below the surface were burials dating back to about 2700 B.C., and we dug down some eighteen feet till we reached burials for which 3500 B.C. seems the latest possible date. It would be difficult to describe the continuous thrill under which we laboured for the space of ten weeks.



GOLD DAGGER, FIVE THOUSAND YEARS OLD.

This is seen lying in the ground just as it was discovered at a depth of eighteen feet. Probably made about 3500 B.C., the dagger is attached to a leather and silver girdle, and a cylinder seal and gold vanity case adjoin it.

Burials came so thick and fast that our small staff could only with difficulty cope with them; gold we found on every day of the last month, and every day revealed treasures baffling to the imagination for their antiquity, their novelty, and their value. Methods of burial were various. Most commonly the body was wrapped in a shroud, placed between two reed mats, and laid in a pit. In the earliest period a fire was then lit around the head; but the body was only partially cremated, for while the flames still soared aloft earth was thrown over it. Thus we would find the head very heavily burnt, the body often only lightly charred though invariably too far gone to allow of identification of the sex. Later on this practice of partial cremation was abandoned and the body was buried unburnt, but sometimes it was more elaborately housed: now in wooden coffins, now in wicker-work baskets, now in baked clay larnax graves. A very distinctive feature of the cemetery is the presence of large urns containing sometimes a few animal bones, sometimes a baked clay crescent moon. Possibly, as Mr. Woolley suggests, they are votive deposits, or possibly each may be a cenotaph devoted to the memory of a warrior who perished in some foreign war. They were in a proportion of about one in thirty of the burials.

All around the body were placed the treasures and the utensils that might at once delight the soul and be useful to it either in its journey to the world beyond or in the new abode itself. There was a wide variety of objects, but one class was invariable, namely, the pottery. Whatever else might be given, food and drink were essential, and we often found the remains of dates, grain and vegetable matter in vessels of clay or of stone. Little was found of sculptural work, but there was one outstanding object. This was the fragment of a white limestone plaque probably intended to be hung on a wall. The scene represented upon it appears to be the funeral of a king. An empty chariot is drawn by four lions who are guided by a warrior. Resting in the chariot is the king's panoply, his spears, battle-axe, a quiver full of arrows, and a leopard skin. Behind the chariot there follow two more warriors. This bold piece of carving,

executed well before 3000 B.C., is one of the earliest of its kind known in Mesopotamia. Of copper objects there was a great abundance; pots, pans, cauldrons, bottles, lamps imitated from the shape of a shell such as are in use in parts of India to-day; for the protection of the person, pins, knives, axes, adzes, and a variety of oddments too numerous to describe. Curious were a triple-pronged fish spear of the type used by the Arabs on the Hamar lake to-day and a gaff. Interesting was the discovery of the local bootmaker's grave: Buried with him was the bradawl that had been so useful in his lifetime. This bradawl was exactly of the type used by the shoemakers of to-day; it had a copper stem and a sausage-shaped handle made of bitumen. There

were several excellent specimens of wooden-handled copper razors to remind us that the modern world for all its progress in metallurgy has lost the art of tempering copper. The secret is buried with these ancient Sumerians. Many of the wealthier occupants of the cemetery inclined to silver rather than copper vessels, and for the adornment of the person it was very common in the form

of tiaras, bangles, decorative combs, and ear-rings.

Scrupulous attention was to be paid to the person even in after-life: cockle shells with many varieties of paint are the invariable accompaniments of women's graves. Bone combs, manicure sets, consisting of metal cases of copper, silver, and even gold—shaped like a dunce's cap about three inches long—are very common. These contain in them a series of miniature instruments—tweezers, file and stiletto attached to a ring. Prominent, too, were gaming boards and gaming pieces. The boards were often elaborately and artistically executed. Generally they were made of square pieces of shell and had figures of animals, lions, dragons and panthers engraved upon them. Usually colour was applied; sometimes these boards had the appearance of a series of joined dominoes, the discs being inlaid on the face in lapis lazuli.

Of the gold objects we have not yet spoken; of this, the most precious metal of antiquity, there was an amazing profusion. Commonest of all were the ear-rings, sometimes lunar in shape, sometimes consisting of several coils of wire, thick or thin, to suit



FRAGMENT OF PLAQUE IN FINE LIMESTONE.

The scene appears to represent the funeral of a king. This carving was unearthed in the cemetery and is one of the oldest of its kind found in Mesopotamia, being dated before 3000 B.C.



the taste or purse of the owner. There were gold cloisonné work pendants inlaid with lapis lazuli and carnelian, gold rings with filigree decoration, gold diadems, one with a hunting scene impressed upon it, a minute piece of work with a genuine feeling for animal life. Among the amulets was a beautiful little gold bull with a false beard attached to it, "the sacred bull of heaven" as the Sumerians called him, and there was a minute gold dove perched on a gold ball about four times the size of a pin's head. Many thousands of gold beads were numbered among the countless necklaces that we found in the tombs. These were generally interspersed with semi-precious stones, lapis lazuli and carnelian being the most common, while banded sard, jasper, haematite, paste and silver beads were also found. But it was the last day of the season that revealed to us the pièce de résistance. At the lowest level of all, eighteen feet below the surface, from a tomb already rich in gold, there emerged sparkling in the sunlight a gold dagger radiant in its sheath. It was attached to a leather baldric that had a coating of silver. The sheath, about a foot in length, was of worked gold and was divided into squares of lattice-work decoration. The handle was of lapis lazuli set with gold studs. Shown apart from its context it might be a work of the Italian Renaissance. Actually, all available evidence for the dating of this piece (unique in the history of Mesopotamian art) proves that it cannot have been made later than 3500 B.C.

Space will not permit detailed discussion of the many problems, both racial and chronological, raised by the discovery of this cemetery. Suffice it to say that the topmost stratum of the ancient cemetery contains objects Akkadian in style, and that on one of the numerous cylinder seals that give us such valuable dating evidence, we found at this level the name of the daughter of Sargon of Akkad. This gives us a date of 2700 B.C. Only in the second couche did we find objects corresponding to those found by Mr. Mackay in the "A" cemetery at Kish two years ago. These were dated by him between 3200 and 2900 B.C. His date was confirmed by the corresponding finds in the Ur cemetery, for at the level at which objects of the Kish type were

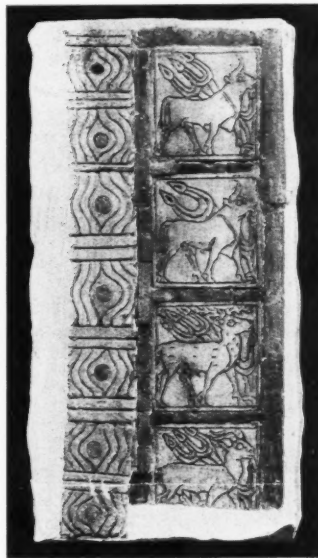
forthcoming we found upon a cylinder seal the name of the King Mesannipadda, whose date is now fixed at about 3100 B.C. Beneath this again we have a period revealing a substantial gap in time; further investigation and examination of results may even reveal to us not one but two periods. We find in the third couche clay inscriptions at a stage between the pictographic and the fully-developed script. The burnt level is lowest of all, and it is hereabouts that the gold dagger was found. Meanwhile, for every

level the pottery and the countless vases of alabaster and other kinds of stone change in shape and technique and form an invaluable aid in our sifting of the periods.

Most interesting was the discovery of a number of gold chains: two were made of twisted strands of gold wire contrived to give the appearance of gold links; but there were others with genuine links that would do credit to a jeweller of to-day. One of these is spaced with beads of lapis lazuli, another is the exact counterpart of a gold chain found by Père D'Orme and Dr. Thureau Dangin at Tirga on the Euphrates. Tirga is a city over two hundred miles north-west of Babylon. Inlay jewellery and chisels similar in style and technique to objects found at the lowest levels in the Ur cemetery were also found on this site. Thus at the earliest period known to us Sumerian arts and crafts were to be found

at least as far north as Tirga and as far south as Ur.

Sumerian culture was no small thing confined to one or two insignificant cities, but one that had permeated in all directions in the land of the two rivers. Further work will enable us to draw inferences far stronger than these. For the present we must take stock of our results and rejoice in the expectation of fresh evidence to come, for it was only at the last that we lighted upon the richest portion of the cemetery. At the beginning of next season we shall return to the rich vein that we were fortunate enough to strike at the end of our last campaign. Who knows how many earlier stages of this already advanced art excavation will yet reveal, and from what hoary antiquity this venerable civilization is descended?



AN EARLY GAMING BOARD.

The figures are engraved in shell, while the discs, inlaid on the surface in lapis lazuli, suggest in appearance a series of joined dominoes. (About 3200 B.C.).

## The Problem of the Black Sheep.

By F. W. Dry, D.Sc.

Department of Textile Industries, University of Leeds.

*Following a series of experiments on the inheritance of colour in a local breed of sheep, the University of Leeds is now in process of founding a pure white flock. How the characteristics that appeal to the stock-breeder are related to colour is under investigation, tradition in these matters having had considerable influence hitherto.*

BLACK sheep are of proverbially wide distribution, but in the Wensleydale breed the proportion of black lambs is specially high, in spite of the fact that in pedigree

flocks black animals are not allowed to become parents. The breed therefore seemed a good one for an attack upon this ancient colour problem. It was obvious at the outset that the problem was a "mendelian" one, that is to say, it concerned the principles of inheritance first enunciated by the famous Austrian, Mendel. As a result of his researches, certain contrasted inherited characters were found to be "dominant" and others "recessive," and from this the resulting characters of offspring

might be predicted according to those of the parents. In sheep one has been attempting the kind of thing that has already been done quite thoroughly with animals like mice and rabbits, which are such convenient subjects for studies in the inheritance of colour. A knowledge of colour inheritance in other animals has served as a guide, but in each particular case the details have to be worked out separately. The slowness with which sheep breed and their large size constitute practical difficulties, but facts learnt from breeders, and especially flock records covering a quarter of a century, gave a good start to the investigation. The problem has fortunately proved much less complicated than many that have been solved in the small quick-breeding rodents. The inquiry began with visits to breeders in the dales of the North of England in 1921. The next year breeding experiments were undertaken, and in the

autumn of 1925 it was possible to begin the building up of a pure white flock.

The Wensleydale sheep in demand in the show-ring

and sale-ring has white wool, but the skin of the extremities of the body, especially the face and ears, is deep blue. The deeper the blue, the more aristocratic the animal. The breeders themselves, while insisting—on grounds that will be discussed shortly—upon the deep blue colour, associate the throwing of black lambs with this complexion colour. On the average fifteen per cent of the lambs are black, while, on the other hand, some of the white lambs fall below the standard in the matter of complexion. A very

occasional ram used in pedigree flocks proves to be the father of nothing but white lambs. Nearly all such animals have been found rather lacking in colour within the ears, being usually "coppery" in that region rather than blue.

To establish a pure white flock, as will be shown a little later, will require at least some patience. A pure black flock offers no difficulty whatever.

Two gentlemen residing in the middle of parks thought a flock of blacks would add a picturesque touch to the surroundings, and so bought up blacks and bred from them. Every lamb was black; the "recessive" colour, black, breeds true. For the purpose of this research the owners of the black flocks, in which some six hundred lambs were in all born, were carrying out breeding experiments, and that in a very thoroughgoing way. Even more important were flock records. The patient recording, over



BLACK LAMBS FROM WHITE SHEEP.

White Wensleydale ewe with two black lambs; the father was white.

a quarter of a century, of the parentage and colour of the lambs in the flock under his charge at Underley, near Kirkby Lonsdale, on the part of Mr. G. Goland Robinson, carried out with no thought of the purpose to which his data would ultimately be put, laid the foundation of the work now described. From a statistical study of these records it was possible to conclude, without any breeding experiments, that white is a simple mendelian "dominant" to black. The fact that the genetic relation between the two colours is of the simplest kind makes the project of establishing a pure-breeding white flock much less difficult than it would be if matters were more complicated. Furthermore, observations in flocks have led to the conclusion that animals pure for white are on the average, though only on the average, less blue inside the ears than those that are impure.

We thus see that in selecting for deep blue colour inside the ears, breeders are keeping up the numbers of impure whites, and therefore the numbers of black lambs born, though these lambs are themselves not taken into the breeding flock. The few rams needed in a flock can be selected with particular care, but with the ewes it is not possible to maintain the same colour standard, and many which are pure whites, and therefore never have blacks, are retained for breeding. This explains why the proportion of black lambs born is not one in four—the ratio expected if all the sheep in a flock were impure whites—but something like one in seven. It is calculated that two in five of all white Wensleydale lambs born are pure whites. It is from the bluer animals, from impure whites, that nearly all the rams for pedigree flocks are chosen.

In these breeding experiments, which are now coming to an end, the various matings necessary to work out the relations between the colour types existing in the breed have been made. Perhaps the most striking experiments are those in which two rams possessing white records in ordinary Wensleydale pedigree breeding have been mated with black ewes. In Mendelian terms this is merely mating the pure

"dominant" with the "recessive." As expected, all the lambs, to the number of fifty, have been white.

Probably the most instructive experiments are those in which animals of what we may regard as a modified black type, "silver-grey," have been mated together. In this type there is a considerable admixture of white fibres amongst the black ones. It seemed not impossible that white lambs might be obtained from the silver-grey parents. Such recessive whites, were they to appear, would in all probability breed true. No such whites have come. Most of the lambs in this mating have been silver-grey, a few black. Silver-grey, it would seem, is a simple "dominant"

to black but is, of course, "recessive" to white. White, silver-grey, and black are thus regarded as forming what is called an "epistatic" series. The practical conclusion is that the building up of a pure-breeding white flock must be secured through those white animals, pure for the dominant factor which keeps black pigment out of the wool, which never have black lambs whatever colour their mates may be.



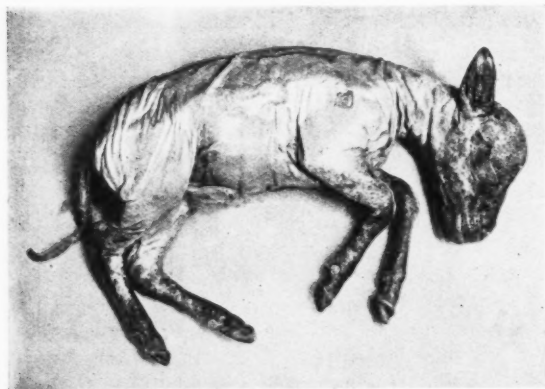
PRIZED FACE MARKINGS.

Young Wensleydale-Blackface ewe. The face markings of this animal are considered ideal by breeders, yet the significance attached by them to face colour leads to breeding practices which keep up the proportion of black lambs.

In the autumn of 1925 a flock of some twenty ewes was got together by the University of Leeds which, judging by previous lambing results, by the colour of the inside of the ears, and in some cases by parentage, seemed likely to include a considerable proportion of pure whites. The two rams used had already shown themselves to be pure for white by their breeding performance. The lambs, born last year, are all white. If any ewes are impure for white they may have produced impure white lambs, and so half a dozen ram lambs are being tested to ascertain whether they are pure whites. Each has been mated with at least eight black ewes. When the lambs have come any ram that has sired eight lambs, all whites, may be regarded as having passed the test. The ewes of the white flock have been mated with two more pure white rams. The 1926 ewe lambs are all being kept and some of them will be taken into the breeding flock in the autumn of this year.

It is stated sometimes that the deep blue colour is associated with a characteristic of economic importance. That colour and some vitally important property may be the expression of the same Mendelian factor is well known. Yellow mice become excessively fat, and individuals pure for the yellow factor perish unborn at an early stage of development. Here must be explained the place of the Wensleydale breed in the sheep world. The function of the pure Wensleydale flocks, which are generally quite small, a flock of twenty ewes ranking as of fair size, is to provide rams for cross-breeding. These rams are very frequently mated with black-faced mountain ewes. Now breeders desire the lambs from this cross to have mottled faces with the markings dark. Some state that such animals have the advantage in leaner mutton, others that those with the coloured areas of the head light brown instead of dark brown are likely to be delicate. It is also often stated that Wensleydale rams deep blue about the head region are the most likely to bring crossbred lambs of the kind desired. Black Wensleydale rams are often said to possess the same advantage. Now a flock of pure-breeding white Wensleydales must be expected to be somewhat lacking in colour within the ears, and it was therefore necessary to pay some attention to the beliefs that have been mentioned.

The evidence that has been collected from butchers and from breeders has led to a verdict of "not proven" on all counts. Although the colour or markings of the face may make a big difference in the market value of even a purely utility sheep, I have come to the conclusion that these preferences are simply formalism or fashion. In the colour of livestock,



WENSLEYDALE FOETUS.

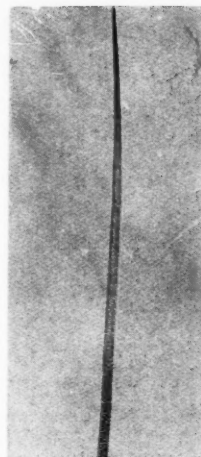
The wool, just beginning to grow, is white, while the skin on the extremities of the body, as is usual in the Wensleydale breed, is pigmented. The mother was black, the father white. Like most impure whites this lamb has dark blue ears.

fancy, as is well known, has great vogue in the show-ring and sale-ring. One breeder has in effect put the matter in this way: "If we can have sheep that are good in carcase and wool and have them with handsome faces too, well, let us have the pretty faces!"

The choice of impure white Wensleydale rams that come to be used owing to the prevalent tastes and beliefs where face colour is concerned results in certain crosses in some lambs being black that would otherwise be white. The policy in the white flock of the University, therefore, will be frankly to disregard the fashion in complexion colour, and to turn out rams guaranteed not to sire blacks in the confidence that they will find some sphere of usefulness either at home or abroad.

An attempt is being made to tackle, or to pave the way for doing so, the fundamental problems encountered in the work on sheep by work upon smaller animals. In the Wensleydale, as in many other breeds, white depends upon a "dominant" suppressing factor. We should like to understand how this factor inhibits the production of pigment, and to find some method other than the slow breeding test that now has to be employed, of distinguishing the pure from the impure white. The same problems are presented in the ticked coat of the wild mouse. The wild colour type is much more elaborate than the "fancy" black one, but there is a key to the wild pattern.

If we confine attention to hairs that have grown at the same time it is possible to say that on the back of the mouse the presence or absence of a light band—pale black, pale black and yellow together, or yellow alone—can be correlated with hair type, and in types possessing the band, its length and shade can be correlated with the size of the whole hair or of some part of it. It is safe to conclude that, when in a wild mouse part of a hair is paler than it would be in a black mouse, this is because the production of black pigment is partly or completely inhibited. Wild type is a simple "dominant" to black, so that the problem is essentially the same as the one which challenges us in the Wensleydale sheep.



WILD MOUSE HAIR.

This has a sub-apical yellow band, which can be correlated with hair type. Small animals like mice provide useful means for experiment on fundamental problems of genetics.



## Coal Gas as an Illuminant : A New Review.

By A. T. de Moulpied, M.Sc., Ph.D., F.I.C.

*As a result of a restatement of the accepted history of the use of coal-gas as an illuminant, in an earlier article by Dr. de Moulpied in these pages, we received some correspondence concerning another claimant to this discovery. Further investigations of the matter have produced interesting new facts.*

IN a short article in *Discovery*, written in remembrance of Faraday's discovery of benzene,\* I stated, in passing, that the credit for the first use of coal-gas for domestic lighting belonged to William Murdoch. Encyclopedias and textbooks enshrine the tradition and agree that Murdoch used coal-gas in 1792 for the lighting of his house at Redruth. It may be that these authorities and the writer, anxious as they are not to repeat themselves, are merely repeating each other and that this claim is not beyond challenge.

### Early History.

It has been urged, in loyalty to the memory of an earlier worker, that in repeating this statement I was unwittingly unjust and historically inaccurate. My duty was clear and was made the easier by the provision of new data which I have considered in relation to other established facts. The following summary, while not claiming to be complete, may serve to establish a little more exactly the sequence in the early history of a discovery of first importance to civilization.

The issue of inflammable gas from the earth is a phenomenon which must have been noted by many who have left no record of their observation. In the early years of the seventeenth century, there is evidence that Jean Tardin made such an observation with regard to a "fountain which burned" near Grenoble. In 1659, Thomas Shirley visited a spring on the Warrington Road, near Wigan, which had the reputation of yielding water which burnt like oil. Shirley investigated the phenomenon and his experiments and conclusions are recorded in the *Philosophical Transactions* for 1667, under the title "Description of a Well and Earth in Lancashire taking Fire by a Candle approached to it." There was method in Shirley's investigation, and he established that the spring produced an inflammable substance which was not the water; he observed a bubbling in the spring and something comparable to a wind, and decided that the "bituminous or sulphurous fumes" came from coal. The water was

then kept out by a dam and the issuing gas ignited to give a flame some eighteen inches high, which "burned very bright and vigorous." It was well known at the time that there was a good deal of cannel or candle coal in the neighbourhood.

So far we have intelligent observation rather than discovery. The next stage centres round the Rev. John Clayton, D.D., 1657-1725, some time Rector of Crofton near Wakefield, Dean of Kildare, a member of that most interesting band of clerical scientists which includes Roger Bacon, Stephen Hales, Richard Watson, Joseph Priestley, T. G. Bonney and, in our own day, the Abbé Senderens. Mr. Walter T. Layton has recently published\* an account of the life and work of the Rev. John Clayton, "Priest and Philosopher," in which the facts are set out for the first time, with scholarly thoroughness and with much charm. John Clayton re-investigated the Wigan gas spring already examined by Shirley, but, as will be seen, he did so much more, that one may readily accept Mr. Layton's claim that "it appears to be beyond question that Dr. Clayton was the first to record the fact that the distillation of coal would produce an illuminating gas that could be collected and stored for future use."

There is no mention of the Dean of Kildare in the "Dictionary of National Biography," which notices seven other John Claytons – and credits John Clayton, the botanist, with some of the achievements of the Rev. John Clayton, Dean of Kildare.

### The First Record.

The date of Clayton's work is difficult to fix accurately, but Mr. Layton adduces cogent arguments for fixing 1684 as the year of his investigations. In the *Philosophical Transactions* of 1693 is published a letter which Clayton wrote to the Royal Society in 1688, giving an account of some observations he made in Virginia, "more particularly concerning the Air." Commenting on the nature of thunder, Clayton compares it "with some sulphureous Spirits which I have drawn from Coals, that I could no way

\* "Benzene, 1825-1925." *Discovery*. Vol. VI. No. 66. p. 223.

\* "The Discoverer of Gas Lighting." By Walter T. Layton. (Walter King Ltd. 1926). I wish to acknowledge my indebtedness to this book for some important dates and for sending me back to the original documents.

condense, yet were inflammable, nay would burn after they had passed through water, and that seemingly fiercer, if they were not overpowered therewith. I have kept of this Spirit a considerable time in bladders, and tho' it appeared as if they were only blown with the Air, yet if I let it forth and fired it with a Match or Candle, it would continue burning till all was spent."

#### An Undated Paper.

This first paper in the *Philosophical Transactions* was overlooked until Mr. Layton drew attention to it, while attention had been centred on a second and undated paper which was first published in the *Transactions* for 1739-40. The manuscript was found among his father's paper by John Clayton's eldest son, Robert, Bishop of Cork, who sent a copy of it in 1740 to the Earl of Egmont, F.R.S. Dr. Robert Clayton stated in his covering letter that "if the Gentlemen of the Royal Society approve thereof" he would not be averse to publication as "some of the matters therein contained are of no small concernment to mankind." The paper is in Volume XLI, pp. 59-61 of the *Transactions*, and the manuscript itself is in the British Museum. The paper is entitled "An experiment concerning the Spirit of Coals, being part of a letter to the Hon. Rob. Boyle Esq." It is particularly interesting to find Robert Boyle, discoverer and pioneer of scientific thought, in the role of friendly receiver of the discoveries of others.

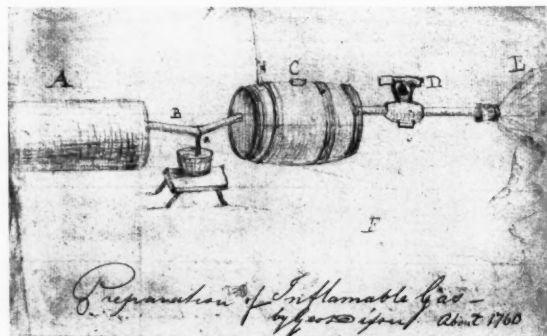
There are no details given in the paper as to the dates of the experiments, nor is the date known of the letter to Boyle, but the work must have been done prior to 31st December, 1691, the date of Boyle's death. As already mentioned, Clayton's first paper in the *Philosophical Transactions* of 1693 was based on a letter of his written in May, 1688, recounting observations made by him in Virginia, which he visited some two years before. With some certainty, therefore, the experiments done by Clayton on the "Spirit of Coals" can be assigned to a date earlier than 1686.

This second paper, whose publication was delayed for fifty years, is based on a visit to the ditch near Wigan, "wherein the Water would seemingly burn like Brandy." At this time the Manor of Adlington near Wigan was owned by Thomas Clayton, an uncle of John Clayton and it may readily be imagined that during some vacation visit to this uncle, the Oxford graduate heard of the local phenomenon of the burning spring, and that his alert and resourceful mind was stimulated to investigation. Clayton, like Shirley before him, proved that it was not the water which

burnt, nor the steam which arose from the ditch. He "hired a person" to dig into the ditch, and, in his own words, "When he had dug about the Depth of half a yard we found a shelly coal, and the Candle being then put down into the Hole, the Air caught Fire and continued burning."

That a marked change in the chemical composition of the gases evolved had taken place during the thirty years separating the investigations of Shirley and Clayton is clearly shown in their respective descriptions. Shirley says that the flame he obtained was very bright and vigorous, and the comparison with the burning of oil is readily understood. Clayton compares the burning with that of brandy, and the pale flame he obtained was probably due to the combustion of what was mainly marsh gas.

Clayton then obtained coal from the neighbourhood and distilled it in a retort, obtaining in sequence "phlegm," a "black oil" and a "spirit" which he could not condense but which forced his lute and caught fire and could be "lighted again" if blown out. He then fixed a receiver on to the retort and a squeezed bladder on to the other end of the receiver and so filled the bladder. He points out how many bladders he filled from the distillation of an "inconsiderable quantity of coals" and adds that he might have filled an inconceivable number more. He observes further that the spirit could be kept a considerable time in good thick bladders, and that his various attempts to condense it were in vain. "When I had a Mind to divert Strangers or Friends, I have frequently taken one of these Bladders, and pricking a Hole therein with a Pin, and compressing gently the Bladder near the Flame of a Candle till it once took Fire, it would continue flaming until all the Spirit was compressed out of the Bladder." One recalls the pleasure with which Priestley, long after,



SKETCH OF GEORGE DIXON'S APPARATUS.

In this George Dixon illustrated his method for distilling coal, the portion marked "E" on the right being, apparently, a bladder for collecting the gas. The date ("about 1760") has been added to the original sketch.

amused his friends with his "random" experiment based on the explosion of a mixture of hydrogen and oxygen.

It is at first sight surprising that Clayton makes no specific reference to the luminosity of the flames he obtained, particularly in view of the contrast in this respect with the pale flame of the burning gas in the Wigan ditch. It must be assumed that the distillation at a relatively low temperature of a cannel coal produced a gas burning with a luminous flame. It is tentatively suggested that the verb "to light" had, in the seventeenth century, a different connotation from that of to-day, when it is synonymous with "to ignite" without any reference to light or luminosity. Clayton does not use the word "lighted" in connexion with the Wigan natural gas, but says that it "caught fire."

Viewed in the light not of an isolated observation but of a series of steps logically conceived and skilfully executed, the Rev. John Clayton was the first to place on record that the destructive distillation of coal yields an inflammable gas insoluble in water, a gas which can be separated from the water and tar produced, collected, stored, delivered under pressure, and ignited at the point of liberation. These are indeed the essentials of modern practice. There is no indication in the papers quoted that Clayton thought of putting coal-gas to any practical use, but all may agree that he did enough for fame and for grateful and permanent recognition.

A definite practical step towards the use of coal-gas as a domestic illuminant was taken by George Dixon (1731-1785) of Cockfield, Co. Durham, to whose experiments justice does not appear to have been done in technical literature. I am indebted for my information to his great-great-grandson, Mr. Waynman Dixon, M.I.C.E., and to Mr. J. A. L. Robson.

#### "The Original Inventor."

In 1810, John Bailey of Chillingham published his "General view of the Agriculture of the County of Durham," and devoted a section to "manufactures" under which coal tar is included. Bailey states that the first works in the county for extracting tar from coals were established at Cockfield in 1779, "by the original inventor, the late very ingenious Mr. George Dixon." Lord Dundonald was granted a patent in 1781 for making coal tar, but it would appear that tar from Dixon's factory was in use at least two years earlier.

Bailey then gives the following account of Dixon's experiments on the use of coal-gas as an illuminant:—"He had discovered the process for extracting tar from coal upwards of twenty years before he began to



GEORGE DIXON (1731-1785).

From an hitherto unpublished portrait, by his son (1760-1812). According to contemporary evidence now brought to light, George Dixon took practical steps towards the use of coal gas as an illuminant as early as 1760, over thirty years before William Murdoch's celebrated experiment at Redruth.

manufacture it for sale, as I remember being much amused when a little boy, by his filling an old tea-kettle half full of coals, setting it in the fire, and luting a tobacco pipe\* with clay to the spout, and to this several others round the end and side of the room; after a certain time he put the flame of a candle to the end of the farthest pipe and immediately a bright flame issued from it, where nothing was perceptible before; he then made small holes with a pin through the clay that luted the pipe heads and shanks together, and applying the flame of a candle to each, there were as many flames as pipe heads. He had only made the discovery a little before this, and this was probably the third or fourth exhibition of illuminating rooms by gaslight. This mode of lighting rooms was for a long time a favourite project with him, and he had thoughts of lighting his collieries with them, but was cured of it by the following experiment, at which I was present."

\* The family tradition is that the pipes were made of hemlock stems.

The experiment was made to determine how much tar could be obtained from one ton of coal. The coal was heated in a boiler and towards the end of the experiment a light was applied to the tar outlet. "The inflammable gas immediately burned with a large bright flame; to extinguish this he struck it with his hat; the flame was driven inwards, the gas in the inside of the apparatus took fire as quickly as gunpowder, and exploded with a report like a cannon, driving out the wooden plug to a great distance and exhibiting a cylindrical body of fire of several yards in length."

Dixon not unnaturally gave up his project of lighting rooms and collieries as being very dangerous, and Bailey states that he records the experiment as a "useful hint to those who are at present engaged on similar projects of lighting manufactories and great towns with a material so subject to explosion." This first experimental lighting of a room by means of coal-gas must have been carried out, on the evidence given, about 1759 or 1760, over thirty years before William Murdoch's larger scale experiment at Redruth.

No evidence has been found to show whether Dixon's experiments had any influence on later work. It is hoped, however, that the name of George Dixon may now be remembered among those of the pioneers to whose originality, resource and perseverance, the gas industry traces its origins, and upon whose early work it has erected, through the efforts of many successors, the splendid structure of our own day.

#### A Sequence of Effort.

It is not proposed to deal with Murdoch's work, concerning which so much has already been written. It must not, however, be supposed that the establishment of a sequence of effort detracts in any way from the great achievement of Murdoch, who may well have been in ignorance of earlier work. The diversion provided by Clayton for his friends, and the experiments and the abandoned project of Dixon became, in the vigorous and capable hands of Murdoch, a reality and the basis of practice which has known no break since his day.

A consideration of the facts detailed suggests one or two observations.

The establishment of a true lineage is of vital importance in the history of scientific discovery, and it is something more than a pious duty to search for origins and to examine the state of knowledge and the conditions of the times in which discoveries occurred. The old saying is that a straw shows which way the wind blows. If we know the direction of the wind, it is easier to understand and to predict

in what direction the straws, save one or two rebellious ones, will move. It is then possible to assess more accurately the effect of the dead-weight of traditional thought, say in the Phlogistic period, and to appreciate, at its worth, the rebellion of a Lavoisier and the effect of the liberating touch of one great discovery.\*

Simultaneous discoveries cease to appear merely as the result of chance, but find a more rational explanation. When knowledge and the means of inquiry lead many to ask the same question, it is certain that some will receive the same answer, and highly probable that more than one may understand it. It diminishes in no way the stature of men whose debtors we are, to recognize that certain times in the past have been more favourable for particular discoveries than others.

#### The Historian's Problem.

The independent discovery of oxygen by Scheele and Priestley, of Neptune by Adams and Leverrier, of the synthesis of alizarine by Perkin and Caro, of the conception of the asymmetric carbon atom by le Bel and van't Hoff, may be cited as examples. For the historian, there is sometimes the difficult and fascinating problem of assigning rightly a discovery to one of several claimants, of assessing the relative value of the seeing eye, the understanding mind, and the practical hand. Cavendish was the first to isolate from the nitrogen of the air a small part which differed from the rest and whose amount he estimated. Can it be said that Cavendish was the discoverer of Argon? To whom shall the credit be given for the production of synthetic indigo from phenyl glycine—to Heumann, who first accomplished the synthesis, or to the German firm who by a wonderful effort overcame enormous practical difficulties?

There is no general method of assessing merit in these cases, but increasing knowledge, allied to the scientist's sense of justice, leads in time to a true valuation of effort. Special praise is due, accompanied sometimes by special reward, to whoever converts a discovery into something practically fruitful, whether it be a new principle leading to fresh discovery, or a new method of manufacture leading to industrial prosperity. Seen in this light, the names of Clayton, Dixon, Murdoch, and their successors all have their own distinctive place in the history of the discovery which forms the subject of this note.

\* Before Lavoisier established the connexion of combustion with oxygen, it was supposed that every inflammable material contained "phlogiston," a substance to which this property was due.



## Europe—America in Two Hours?

By Max Valier.

*A good deal has lately been heard of proposals to shoot rockets to the moon. The author of the following article, a German aviator and astronomer, is making experiments with a view to evolving from the modern aeroplane a type of space ship, which he considers should be able to cross the Atlantic in two hours. The project is commented on in the editorial notes.*

THE world has become smaller and its distances shrink almost daily; not from the point of view of the geologist, who calculates that thousands of years will elapse before, by cooling, the earth will shrink up into a small globe, but in the sense of the technical engineer, who by application of ever-improving means of travel shortens the distances over the earth's surface.

For what are distance, speed, and time? A hundred miles is a long way: four days' march, if one attempt it afoot; for the cyclist a good days' pedalling; for the express train not much over an hour's steam; and a mere trifle over half an hour for the aeroplane. The shell from a modern long-distance gun, such as was directed on Paris in 1918, would traverse the hundred miles in three to four minutes; speed, in fact, eliminates distance.

Although not half a century has elapsed since Jules Verne wrote "Round the World in Eighty Days," which was then considered fantastic, it is now possible to cover the distance in one quarter the time. But this is still too long for some purposes. We should be able to accomplish the feat in a day, in a few hours even, and then proceed to throw a bridge across space to the Moon, our nearest neighbour in the solar system. Only by flight will this be possible. Our present type of flying machine can never attempt such an expedition, however. The higher it reaches the lighter is the atmosphere and consequently the less its power. As the result present-day height records are restricted practically to what has already been accomplished—a mere eight or nine miles. This is insufficient. We must

go higher—a hundred miles above the earth's surface; five hundred miles even! Only then will the pride of the modern engineer be satisfied. Science also

demands the attainment of greater heights as yet only dreamt of, and explorers of the cosmos are dissatisfied with the fact that we still cling to the earth, for the few miles climbed as yet are unimportant.

It is expected that by means of adjustable propellers, by a preliminary condensation of the air introduced through the carburettor, and by means of various special arrangements of apparatus, better climbing capabilities will be procured, and so enable heights of nine to ten miles or even twelve to fifteen miles to be attained. But we already know that the limits of such aeroplanes will be quickly reached. Preliminary condensing of the air causes an increasingly greater demand on power until at last the gain in



THE AUTHOR,  
who proposes to fly with a rocket apparatus in space.

motor effort through compression is equalized. Above these limits a propeller machine can never be successful and it is improbable that much over fifteen miles above the earth's surface will be accomplished. Only a machine in which the method of working is quite independent of the surrounding air can open the path to the celestial spaces, and then only when it can develop sufficient power and carry fuel in great enough quantity.

The only method likely to be successful is the rocket system. This alone—not the cannon shot!—gives any suggestion of likelihood, especially if we take into consideration the dispatch of living beings into space.

According to the calculations of Professor A. von Parseval, a giant aeroplane flying at a height of ten miles should travel from Berlin to New York in 28 hours 40 minutes. The machine would be of 50 tons weight, with cargo space for  $9\frac{1}{2}$  tons. With a fuel-carrying capacity of 19 tons, it would have a flight radius of 5,200 kilometres at an average speed of 300 kilometres per hour. The flight would be by way of Vigo, where the machine would descend to re-fuel. At 6,250 h.p. the aeroplane would rise at Vigo to a height of 15 kilometres, and continue its flight over the ocean at this height with 5,000 h.p. The fuel used would be  $28\frac{1}{2}$  tons, or three times the weight of the cargo! Conditions would be more favourable if floating tank docks could be utilized in mid-ocean, for in this way the fuel cargo carried could be reduced.

Now consider the same flight with the rocket ship proposed. The start would have to be at a very acute angle,  $80^\circ$ , in order that the thin air stratum be quickly reached. After 17 seconds the ship is calculated to attain a speed of 400 metres per second at 3,000 metres high; after 35 seconds at 20,000 metres high, the rate of progress would be 800 metres per second; and after 45 seconds at 50,000 metres over the sea and 70 kilometres horizontal distance from the starting point, the horizontal speed would be 2,000 metres per second. At this rate, with a support point at Vigo, New York would be reached in an hour and a half. As to fuel,

it must be reckoned that from Berlin to Vigo 69 per cent of the total weight of the ship would be made up of fuel; from Vigo to New York 76 per cent.

For more than three years now we have been reading reports in the press about constructors in different civilized lands who are working on the development

of high capacity rockets. Professor Goddard will, it is stated, send greetings to the moon by a rocket which shall be of a duplicate nature, one rocket driven by powder within another rocket\*; Professor Oberth, one reads further, will send men to the moon and back in a rocket, the driving power of which shall be a fluid propellant. More modestly, von Hoefft of Vienna, will send a *Sondier* adjustable rocket sixty miles into the unknown.

There is another path of development in this sphere of activity, namely by way of the present aeroplane to the eventual space ship. It is my intention to advance along this path. In the

laboratories, progress is being made with the investigation of a high-capacity rocket with fluid propellant and a new ignition system. A small 7-10 ft. model will be experimented with at first. From this start a normal "chaser" aeroplane will be designed, into the wings of which will be fitted auxiliary rocket apparatus. In this manner it will be possible to study during flight the working of the



FROM PROPELLER MACHINE TO ROCKET SHIP.

Diagram showing the relative heights accomplished by various types of flying apparatus. The first step in the new project is to use auxiliary rockets in the wings of a developed aeroplane with propeller, the number of rockets being increased as experience is gained. Then a machine will be eventually evolved relying solely on the rocket system, and the propeller will be entirely dispensed with.

\* See "Professor Goddard's Rocket to the Moon," *Discovery*, Vol. v, No. 54, p. 90.

rocket as a motive power, and this seems to me to be of great importance in regard to wider developments.

The first thing to do will be to prove that a man can rise to certain heights. Greater and greater heights will be attempted, till all records are broken. When this has been successfully accomplished—and I intend to make the trials myself—I hope to develop the rocket ship to such a capacity that in a few years heights of 150-200 miles above sea-level may be possible, at which heights, I trust, I shall be able to remain for some minutes. If this should be possible the perfecting of the rocket ship to such a degree that it will become a real space-ship should proceed apace.

As soon as a ship can be constructed giving a speed of 12,800 metres per second it can escape, it has been calculated, from the Earth; we shall be able to journey to the Moon, land on its surface, and return again at will to earth; the moon may then become a colony for our world.

As a result of the research work of Professors Ziolkowsky, R. H. Goddard and H. Oberth, together with the common labours of later experimenters, the great idea has been pursued till the view is now generally held that "projection into space" is, with the help of present-day technical media, already within the realm of possibility. On the other hand, voices are being raised in increasing numbers denying the probability of success in such undertakings. It may be of interest, therefore, to consider a few of the most important points for and against and discuss them side by side.

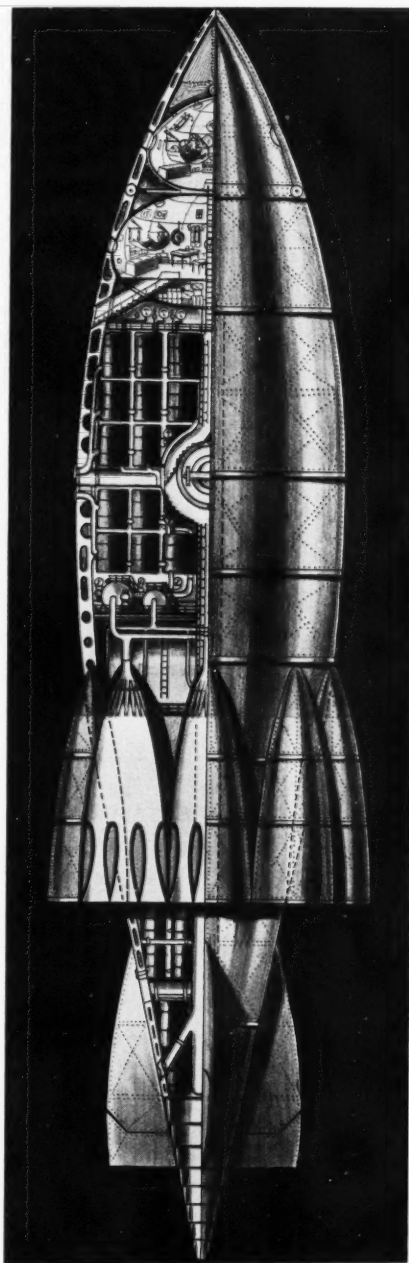
The first and fundamental objection is the illusion that, in

the empty space beyond the earth's atmosphere, voluntary movement and steering is quite impossible, because the motor of the ship, whatever its nature,

will find no resistance for its power development. As the great Newton discovered two hundred and fifty years ago, we may say in reply that in travelling through the atmosphere the rocket does not rely on the support of the air, but moves by its own internal energy through it; the space-ship likewise would move forward by means of the expulsion through the nozzle, as exhaust, of the gas molecules developed by the explosion of the propellant fuel, whereby a continuous recoil would exist (similar to that which occurs, though of brief duration, when a rifle or a big gun is fired) to drive the ship onward.

Whether we are able to build rockets of such colossal power that they will be able to force a passage to a point beyond the field of gravity of the earth and other planets is another question. We can only say that to-day we know the exact formula from which to calculate theoretically the necessary recoil, and we know also the "ideal terminal velocity" necessary to escape the gravitational attraction of the earth, the moon, and the other known planets. On leaving the earth the ship must develop what may be called a "theoretical or ideal velocity"—including the overcoming of the air resistance—of 12,700 metres per second, while on its departure from the smaller and air-less moon, 2,370 metres per second will be sufficient.

The real recoil of the rocket is furnished in the product of the forced-out gas mass per second and its exhaust speed.



THE ROCKET SPACE SHIP.

Design for proposed machine, in which the engine-rooms and passenger cabins are seen in the forepart, the rocket tubes being contained in the tail end.

If the ship itself permits an "ideal terminal velocity" which is equal to the speed of the exhaust gas, then 63.2 per cent of the total weight of the starting machine must consist of fuel; if double or treble the exhaust speed is to be attained, then must 86.5 per cent or 95.2 per cent respectively of the total weight be fuel, and there remains only from 13.5 to 5 per cent of the total for the actual weight of the machine itself, including the cargo.

#### The Problem of Fuel.

Therein lies the greatest technical difficulty of the whole problem with the present flying machines: the liquid fuel carried is at most 35 per cent, the tare weight is about 40 per cent, crew 5-10 per cent, so that 15-20 per cent remains for cargo. If one takes a comparatively cheap and easily-transported fuel, such as powder, the results are a far too small exhaust speed (highest 2,500 metres per second), and therefore insupportable conditions as between fuel cargo and tare weight of the machine. On the other hand, a very high exhaust speed (from 4,000-5,000 metres per second) can be obtained from the explosion of hydrogen with oxygen or of similar fluid propellants of high kinetic power. These, however, are very expensive and too heavy, while, further, much regarding their combustion remains to be investigated. It is for this reason that experienced professional men engaged in this sphere of work consider that in the fuel lies the greatest practical difficulty even when the problem is successfully explained theoretically in other directions.

A further objection is that a space-ship in its rapid passage through the air would burn up like a meteor, and that, even if this danger be surmounted, in the cold of space the ship would become brittle and collapse on the slightest pretext. We are prepared for this! In ascent the speed of the machine can be so regulated by preliminary calculation that it will increase only in ratio to the decrease of atmospheric resistance, and therefore also of the air friction. The danger is more likely to be realized on the descent when the machine—if not retarded beforehand—will enter the highest and thinnest air stratum at a speed of 11,000 metres per second. While we certainly have no experience of control of a machine in the pressureless and ice-cold regions of space we can, before the trial ascent is made, experiment and investigate with a comparatively small model ship in the laboratory.

Though the arguments used in regard to objections so far raised meet the case in respect of space-rocket machines, further points arise when we come to deal with ships carrying human beings. Will the human

occupants of the space-ship survive a journey to the stellar regions? This disquieting question has undoubtedly risen to the lips of every reader of published material on the subject. The following argument can be put forward in reply. It is change of speed, not the magnitude of speed which is the obstacle. We all travel with the earth round the sun at 30,000 metres per second, and with the sun as against the fixed stars at 20,000 metres per second; and again with the group of our neighbour stars, it is said, as against the world-ether at the enormous speed of 750,000 metres per second, yet we are not conscious of it. As against this we notice immediately every change of speed both in degree and in direction as, for example, a jolt on starting, a forward jerk on braking, or a centrifugal skid on taking curves.

Space-ships to carry human beings must be so controlled as to manoeuvre and accelerate within the limits of the capacity of man's organism. This is technically possible, and the pilot of the cosmos will control the steering apparatus and gas lever exactly as the aeroplane pilot does his machine at the present moment. In space, steering can only be effective by the reaction of the ship to the movement of an attached spinning wheel of a gyroscopic nature. The fact that air pressure and composition in the interior of the vessel must be artificially maintained at such a state as human beings are accustomed to on land presents little difficulty.

#### Effects of Gravitation.

But there are various matters which give anxiety when it comes to actual flight in space. From the moment the rocket-motors are stopped, the ship and its whole contents will answer the laws of gravitation just in the same way as does a stone thrown into the air. Although the various parts and passengers will not react upon one another according to these laws, there must be installed various aids such as guide ropes, slings on the walls, iron-soled shoes and magnetic floors, which would help to correct involuntary movement. We do not know, however, if the lack of gravity will not bring about some new form of dizziness, or even unconsciousness. And herein we see the possibility of disaster; what might happen should the pilot become unconscious may be visualized by anyone. It is hardly likely, however, that the heart, except at the start of the flight, would be affected for it would, at least, have lighter work to do, though this point must be fully tested, especially the extraordinary demand made on it at the start.

But experiment is more valuable than discussion, and result is ultimately the only criterion of success.



## The Growth of Language.

By J. L. T. E. Jones.

*Interesting circumstances attach to most of the new words that are continually coming into use. Particularly is this the case in America, as the author shows in discussing the growth of language.*

THOUGH Kipling made a slight overestimate when he suggested that the Americans are four hundred years younger than ourselves, they are still a remarkably youthful race. They have a habit of energy and enthusiasm that the West has lost. There is a story that a blind Austrian was once introduced to an American aged some fifty years, and after a short talk learned with blank amazement and incredulity of his acquaintance's real age. He had supposed him twenty-five at most. In nothing is this national youthfulness of outlook, and almost adolescent love of experiment, shown more than in their dealings with language and the most ingenious aptness of their slang.

### Words and Nationality.

The Englishman has an innate distrust for the new word except, of course, in the case of the technical term for which no synonym exists. As a rule he is entirely out of sympathy with any movement to reform or to add to his language. It is partly for this reason that so little of the current slang of the day attains to any permanence; it is more largely due to the fact that slang is born of special circumstances and with reference to things and fashions which are temporary and transient. War slang, for example, is now almost as archaic as many of the phrases used by the Elizabethans. The great bulk of the people, especially the professional classes, which have always been conservative in such matters, do not originate new words. Almost all the word-coining and phrase-turning that is done is the work of writers seeking to escape from old set phrases. In politics, where one might expect a good deal of word-making, there is singularly little, probably for two reasons: firstly, because the level of speech-making is low at the present day and there is a widespread suspicion of rhetoric; and more because most speakers find it more profitable to address their audiences according to familiar usage and custom. Few English politicians would think of taking a leaf out of Theodore Roosevelt's book. Roosevelt minted new words with a surprising facility. One of his best-known efforts in this direction was the invention of the word "chinafy," which he used to describe the helplessness and desperation to which he feared pacifism would reduce

America. Had an Englishman been speaking it is safe to say the word would have remained undiscovered in limbo, whither it might well be returned. He might perhaps have adapted the adjective Sinetic to his purpose, but more probably he would have been content to convey his meaning by some roundabout phrase.

If, however, we in this country dislike adding to our language, the French are charier still. While there are any number of dialects and a vast amount of slang, permanent additions to the language are few, and any new words or expressions are severely and drastically scrutinized before their admission. In the written word there still lingers the old tradition that a small and select vocabulary is the thing to be aimed at. One Parisian morning paper still preserves such a tradition as regards its leading articles, and as far as possible refuses to sanction additions to its stock of words.

While France, ourselves, and the majority of the Western nations fight shy of innovations in language, this reluctance is more than balanced by the activity of the Americans. Many of their public men seem to go out of their way to manufacture new and more pointed words and phrases. Their newspapers aid and abet them and hail each new assault on the purity of the native tongue with an enthusiasm that is remarkable. The industrial and business men coin words for their goods to a far more general extent than in this country, and the plain man welcomes most of the new words with a zest and alacrity that would send shudders down the spine of our European purists.

### American Lexicography.

As to the methods of standardization and lexicography in America, an interesting account has recently been given by Mr. Spencer Armstrong.\* For the most part the work being done is directed more to the collation and examination of new words than to any overhauling of the language as it exists in the manner, for example, of our philologists who are still engaged on that monumental work of erudition—the Oxford Dictionary. As a matter of fact, little has been done at any time in America on the ground-

\* *Proceedings of the American Association of Lexicographers.*

work of dictionary making, and it is perhaps characteristic that even to-day, according to Mr. Armstrong, the staff of readers and correspondents whom he describes are content when hunting the pedigree of an unfamiliar word to depend upon our authorities, such as Cockeram's "Interpreter of Hard English Words," Blount's "Glossography"—both of the seventeenth century—and then upon Johnson's Dictionary, which first saw the light in the middle of the eighteenth century. When a new word is discovered and ascertained to be freshly minted, the practice of the American lexicographer is to place it on file for some five years. During that period of probation its use and vogue is carefully watched, and if at the expiry of the five years it has become at all popular it is given honourable mention in the dictionary. Even then, however, it is not enough for it to have been popular in the immediate past, and unless it maintains its place in popular favour it is marked for ejection as obsolete and archaic. But in this case fair notice is given before abandonment; it is a stringent rule, however, with American lexicographers that infrequency of use means deletion. It is interesting to note how different is this procedure from our own. If one comes upon an unfamiliar word in an English newspaper article—and there are certain well-known writers who have yet to outgrow their childish love of preciousness—one immediately turns to the dictionary, and the search rarely fails. A flutter of the leaves of any of our standard lexicons will reveal half a dozen or more words which have been dead so far as common parlance is concerned for many years, and which will probably remain so.

#### A War Revival.

Not all words, of course, have to wait for inclusion in the American dictionary, the popularity of some being so instant and so widespread that insertion is sanctioned without delay. Such was the case, for instance, of the word *flapper*, so much in vogue during and after the war, although this was already in the dictionary and is a remarkable revival of what had become almost an obsolete usage. Its reference to the youthful human female occurred as early as 1670, but was never popular and rarely or never used again in this sense until quite recently. It has been, of course, in currency in its ordinary acceptance.

Many of the new American words now appearing in their dictionaries as sanctioned by common use appear, it must be confessed, not merely awkward but positively ugly. Take, for example, "bessemerize" which is, of course, related to the Bessemer process,

and merely means to desiliconize—an equally ugly word of which there is as yet no mention in our dictionaries. It is hard to see the necessity for such a word when synonyms already existed, but point and not elegance is evidently demanded.

Perhaps the most remarkable American words and phrases have been coined by their politicians and stump orators, and many of the phrases in particular are grandiosely comical. As Mr. Chesterton long ago remarked, the Americans, unlike the English, are not acutely alive to the humour of the grandiose and pretentious. Such a phrase as Grover Cleveland's "innocuous desuetude," which was supposed by its author and many other people to mean "harmless disuse," is a good example of this type of humorous verbosity—though, as a matter of fact, innocuous cannot describe a merely passive condition. When, however, President Harding used the word "normalcy," and it was widely hailed as an innovation, it was not new, since its use is recorded at the end of the eighteenth century. But it was represented exactly by "normality," and by the authorized use of *normal* as a substantive it became entirely unnecessary.

#### Business Terminology.

Business men in America, as in England to a somewhat limited extent, are always minting new words to describe trade goods. Thousands of these words are registered; in most cases their application remains particular, but in a few instances it develops a wider reference. "Celluloid" is one of these rare cases. Originally it was invented and registered as a trade name and so—although the fact is forgotten to-day—it was the personal property of its inventor. Again, "vaseline" was similarly coined, but is still owned by its original patentees. There are some odd contradictions in regard to registration of what were originally trade terms. "Grocereria," for example, is patented, while "cafeteria" is not; "aerogram" is personally owned and registered, but radiogram, like telegram and cablegram, is anybody's word. There is of course a good deal of piracy in words. "Tabloid" is a case in point. It was originally the discovery and patented property of a British chemist. Unfortunately, in a sense, for its owner, it became exceedingly popular and was pirated to an unprecedented extent. Law-suits were instituted by its irritated proprietor, who for a time recovered his offspring. Thereafter it was pirated to a wholesale degree, and despite his strong desires to assert his special interest in the word the inventor desisted from further legal proceedings, being advised that they would probably prove disastrous to himself.

Innovators rarely trouble to see that their words are correctly formed to express the meaning they desire. The case is recorded of an American undertaker who designated himself a "mortician." It is true that an enterprising Dorsetshire undertaker once wrote himself down as a "funerealist," and profited by the advertisement the change brought him, while others in the same trade prefer to call themselves "funerary furnishers," but by no stretch of analogy could mortician mean undertaker. If derived from "mortice," whose etymology has nothing to do with death, it might rest on some fanciful idea of joining the body with its coffin in sepulture, but this, it is to be feared, implies too lively an imagination in undertakers—who, of whatever nationality they may be, are notoriously grave and serious-minded people!

As has been pointed out, little slang passes into the body of a language, being for the most part too much a thing of fashion and of the passing moment. There are, however, exceptions. "Highbrow," which admits a purely slang inception, is now very commonly used in this country as well as in the States, and may be found in some of our own dictionaries. The use of "dumb-bell" in its American meaning of "block-head" is still largely unknown here, and is not yet recognized in all American dictionaries. In some cases a slang word after attaining a certain measure of purity by long-continued usage becomes archaic. Such is the word "pelf," which was slang originally and which is now being more and more rarely employed.

Technical terms are, of course, legion. "Radio" is daily enlarging its boundaries. At the present moment there are considerably over 1,000,000 words in the English language. By the end of another century there will probably be several more hundred thousand, if American word enthusiasts continue to flourish as they do now; in which case we may well offer up a prayer on behalf of posterity!

### Another Television System.

It was recently announced that successful demonstrations of television were given by a new system developed by the American Telephone and Telegraph Co., when the Secretary of State at Washington addressed the president of the company, Mr. Gifford, at New York, his face being seen on a screen during the conversation.

Like the first practical system accomplished more than a year ago in England by Mr. John Baird, however, it has still to undergo perfection before its use can become public.

## Correspondence.

### "THE WAR-GUILT QUESTION."

*To the Editor of DISCOVERY.*

SIR,

In your issue for April Mr. R. B. Mowat, in discussing the war-guilt question, refers to the minutes of the Russian Ministerial Council for February, 1914, and suggests that the revelations here are no proof of Russian complicity in war-guilt. May I suggest that in this connexion it is necessary to consider the other Ministerial Conference which took place in December, 1913, as well as the correspondence between the Russian Foreign Office and the Russian ambassadors abroad (published by Professor Pokrowsky—"Aus der Geheim-Archiven des Bauen," Berlin, 1920), in order to come to a clear estimate of the role of Russian diplomacy in bringing about the World War. It is clear from the general trend of these correspondences that:—

(1) Russian statesmen after 1908 felt that no internal revolutionary movement need be feared and that they might direct their diplomacy openly towards getting possession of the Straits and Constantinople;

(2) That this could not be obtained without a war with Germany;

(3) That Russia must not attempt a war with Germany without England's help.

Further, I would point to the Russian general mobilization on the evening of 30th July, 1914, twelve hours before the similar order in Austria and Germany, as strong indication of the desire of the war party in St. Petersburg to bring Germany into the war. Moreover, the conversations between M. Sazonoff and Sir Edward Grey in the autumn of 1912, when the latter visited England (see also above sources) seem to have convinced the former that, once Germany was in a war, England would follow for reasons of naval supremacy. England clearly from these documents would not go to war over a Russo-Turkish conflict, but would only come in if the conflict widened. Was it not likely then that, with such men at the head of Russia's foreign policy, an attempt would be made to widen a Russo-Turkish or Russo-Austrian conflict to a general European one?

For my part I am inclined to think there were two main culprits—Russia and Austria. Germany and England had just composed their economic differences in the East, but enough of the Old Adam was there in both countries, arising out of ten years of naval competition, to wreck the process of reconciliation which would have continued had not the Russo-Austrian conflict intervened.

Yours faithfully,

M. PHILIPS PRICE.

The Grove,

Taynton, nr. Gloucester.

Mr. R. B. Mowat writes:—

"I am obliged to Mr. M. P. Price, who is an acknowledged authority on the pre-war diplomatic documents, for his letter concerning my article. I do not think that it is quite correct, however, to say that after 1908 Russian statesmen directed their diplomacy towards gaining the Straits, if this statement means that they tried to bring about a European war. Isvolsky certainly tried to negotiate an agreement giving Russia the

right to send warships through the Straits. Certainly, also, Russian statesmen recognized that they could not obtain Constantinople without a war with Germany and Austria; and if such a war arose, they were prepared to take advantage of it in order to gain Constantinople. But this is not at all the same thing as saying that they deliberately engineered the outbreak of war. There is no evidence of that, so far as I know, and I see no indication of it.

"That the Russians were the first to order a general mobilization in July, 1914, is, of course, well known. But mobilization is not war; and the Tsar himself besought William II not to regard it as war. The German Government, however, answered the Russian mobilization not with a counter-mobilization (as they were entitled to do) but with a war-ultimatum. As long as an ultimatum had not been issued or a shot fired, there was still a chance for peace; the German Government destroyed this chance."

#### THE FUTURE OF AIRCRAFT.

*To the Editor of DISCOVERY.*

SIR,

So many of the more sensational points and figures in Neon's book, "The Great Delusion"—such as those dealt with in your April issue—have aroused interest and argument among air experts and the public, that attention has temporarily been diverted from the less obvious, but more important, lessons to be learned from a careful study of this book. Neon explains at length the effect of wind on aircraft, and emphasizes the fact that it is a current so far as they are concerned—extending the laws to the flight of birds. It must come as news to many to learn that the effect of a head wind of say ten miles per hour reduces the speed of the greatest airship or aeroplane by ten miles per hour in exactly the same way as it does that of a tom-tit. Similarly, a "side wind" of ten m.p.h. will at the end of one hour's flight have carried both the aircraft and the tom-tit ten miles in the direction towards which the air current is flowing. Neither the aircraft nor the bird, however, feel consciously the force of this air current.

So much for the tom-tit. But as with aircraft, so with birds—there are other models. For many years great interest has been taken in the wonderful powers of flight possessed by the great sea birds, of which the most notable example is the albatross. This bird has excited the admiration of seamen for generations. Since the advent of mechanical flight, however, it has aroused the professional jealousy of aerodynamical scientists. So keen has been the interest that special observations have been made by scientists in the Southern Seas to investigate these marvellous powers of flight, which so transcend all human effort that they are thought to be due to some obscure phenomena which enable the albatross to derive motive power from the air in which it is borne. There are those who hope and anticipate that the secrets of the albatross, or other birds, will be discovered and applied to the betterment of aircraft. This view is clearly demonstrated in "Aeolus"—Major Oliver Stewart's recent book.

These obscure phenomena or secrets do not exist. A bird is no more able to extract power from the wind than is a fish from the currents of the sea in which it swims, and the powers of the birds and fishes have reached finality. The albatross and the tom-tit are subject to the same basic laws, and the powers of the albatross are due solely to its wonderfully efficient physical structure, combining light weight, enormous wing spread and flexibility, with great powers of endurance. These physical attributes are in no way applicable to the development of

aircraft any more than is the anatomy of a Derby winner to land transport.

A belief that there are yet secrets to be wrested from the air is perhaps responsible for the position held to-day by the "science" of aerodynamics in the minds of the public. Great things are expected of this new "science," but the public are doomed to disappointment. Aerodynamics is merely a branch of the general subject of dynamics. It deals with similar fundamental laws, but there are greater inherent limitations to the practical exploitation of these laws than in the case of the older and less fashionable branches of dynamics.

The future of the technical side of aerial transport and the responsibility for placing it on an efficient commercial basis rests with the great engineering profession. Their task is not an enviable one in view of the great developments which the public are persistently led to expect.

The most highly-organized aerial transport system in the world is in Germany. Assistance from the State and other outside sources to the extent of seventy per cent is required to keep this system alive. How such enormous losses can be converted into profits is a problem which does not appear capable of solution. The scope for improvement along existing lines is strictly limited. To bridge the gulf and provide a margin to spare would require some revolutionary invention, implying enormous power and strength with negligible weight.

W. H. HENDERSON,

3 Onslow Houses, S.W.7.

Admiral (retired).

#### THE FILM AND THE CHILD.

*To the Editor of DISCOVERY.*

SIR,

At the request of British Instructional Films Ltd., I am sending herewith particulars of an attempt to improve the standard of films shown to child audiences.

A great deal of controversy rages over the films at present being shown, and the difficulty of improving the position is increased by the fact that the educationists on the one hand and the cinema proprietors on the other seem unable to arrive at any understanding. The position is that those responsible for the upbringing and education of children, although realizing the immense power of the film, whether for good or ill, as an educational factor, do not know nor attempt to understand the intricacies of the film-producing business. On the other hand, while recognizing the influence of education upon present and future picture-goers, film exhibitors and producers are at least entirely out of sympathy with, if not ignorant of, modern educational ideals.

Accordingly, British Instructional Films is attempting to bring about a clearer understanding between these two protagonists and to prove that it is possible to organize exhibitions of films for school children which will be acceptable to the most fastidious and yet at the same time be a sound commercial proposition for exhibitors. To this end they have engaged the Kingsway Hall for exhibition purposes, so that experiments may be made in the heart of London. The consent of the London County Council has been obtained, subject to its approval of programmes, for use to be made of the county council school organization for any assistance that they can give.

It is to be hoped that these exhibitions, which will begin some time at the end of the summer, will go far to inaugurate satisfactory cinematograph displays for children.

Yours faithfully,

39 St. James's Street, S.W.1.

SIDNEY ROGERSON.



## American Discoveries at Corinth.

By Theodore L. Shear, A.M., Ph.D.

Lecturer in Archaeology, Princeton University.

*Following our reference last month to the discovery at Corinth of the long-sought sanctuary of the goddess Athena the Bridler, we have obtained the permission of Dr. Shear to reproduce extracts from a lecture in which he recently described the new excavations. This was first reported in the "Princeton Alumni Weekly."*

WHEN Corinth was sacked by the Romans under Mummius in 146 B.C. and, in the words of Cicero, the "Light of all Greece was extinguished," the soldiers took particular delight in throwing down the works of art, in destroying and defiling them. But our modern municipal experiences with earthquakes and fires prove that destruction is a relative term, and that much more survives a general catastrophe than is actually destroyed by fire or sword. In the famous sanctuary of Athena, the Bridler, there is clear evidence of the results of the Roman vengeance on the Corinthians for the insult to their legates. A charred floor-level is superimposed on remains of the third and second centuries B.C., while above the burned area the earliest objects are coins of Julius Caesar who refounded the city. This sanctuary was one of the most sacred in the city. It was here that Bellerophon, the mythical hero of Corinth, slept one night and in his dreams saw the goddess, Athena, bring a golden bridle and place it on the altar. This bridle he found when he awoke in the morning, and with it he went forth and caught and tamed the winged steed Pegasus. Therefore the sanctuary was called that of Athena, the Bridler, and the winged horse became for ever thereafter the heraldic emblem of the Corinthians. The only evidence for the location of this sanctuary is furnished by Pausanias who visited Corinth in the middle of the second century A.D. But his description of the site as adjoining the theatre is so vague that search for it over a period of thirty years has been unavailing. Fortunately near the close of the latest campaign the sanctuary was definitely located and its north and west walls were uncovered for a considerable distance.

### The Season's Achievements.

My excavations of the past season were in continuation of the work done in 1925. They were conducted under the auspices of the American School of Classical Studies at Athens, of which the chairman of the managing committee is Professor Edward Capps of Princeton. The staff included Mrs. Shear, for the artistic work, and two Princeton associates, Edward Capps, junior, and Richard Stillwell. The achieve-

ments for the year were the discovery of the sanctuary of Athena and the excavation of the great theatre.

The search for the Athena precinct was guided by the appearance of the terrain in the neighbourhood of the theatre. In the area selected for excavation the stratification of the various periods of occupation was usually observable without difficulty, and the successive deposits could be invariably dated by the presence of pottery, terra-cotta figurines, and coins. Near the surface many Byzantine objects lay in company with Byzantine coins dating from all periods of the empire, even back to the very conclusion of the Roman régime. At a lower level successive Roman periods were more or less clearly stratified.

### Roman Remains.

The most conspicuous phenomenon among the Roman remains was the presence of pottery that had been imported in quantity from the far-distant city of Arretium in Etruria. We know that the ware found in Corinth was made in Arretium because of the quality and burning of the clay and because it is stamped with the names of famous Arretine potters. As Corinth was noted for the excellence of its clay and the beauty of its pottery this Arretine ware, which dates from the time of Augustus, indicates the persistence of habit among the Roman colonists of Corinth. Characteristic types of Greek pottery, such as Megarian bowls and Attic red- and black-figured fragments, aid in identifying the residuum of respective periods. Thus this limited area of excavation gives a fairly clear picture of the periodicity of the city's life. The retrogressive culmination is reached at hard-pan, some seven metres below the present surface of the ground, where occur the beautiful but scanty remains of Corinth when she was at the height of her glory in the seventh and sixth centuries B.C. From this period date some graceful architectural revetments of a small building which still preserve their harmonious colours—red, blue, black, and cream. But of special interest in association with the sanctuary are dedicatory offerings, such as small bowls and cups, among which were one thousand five hundred specimens of a single group. Pieces of the drapery of an early terra-cotta

statue are important because they are decorated with the recurrent motive of the winged horse, and two primitive clay idols with solid round bodies and pinched heads may reproduce in a crude way the earliest cult-statue of the goddess. Much still remains to be done in clearing the site of this sanctuary, and it is greatly to be hoped that more remains of the glory of Corinth may here be unearthed.

#### An Historic Theatre.

The great theatre, which adjoins the Athena precinct, is associated in historical records with some interesting events in the life of the city. The murderers of the poet, Ibycus, in the sixth century B.C., were here apprehended when they betrayed astonishment at a flock of cranes flying overhead. This story has been familiarized by Schiller's dramatic adaptation of it from ancient sources. At a later period, in the third century, the theatre figures in a cunning plot by which the city was lost through a woman's vanity and a man's wiles. At this time the town and fortress were held by Nicaea, widow of the tyrant Alexander. But the Macedonian king, Antigonus Gonatus, ardently longed for possession of the citadel as it was one of the strongest fortresses in Greece, and by its position on the isthmus controlled the entire Peloponnesus. Antigonus, however, despaired of carrying the place by storm and, therefore, resorted to a clever stratagem. He proposed a marriage between the widow and his young son Demetrius. Nicaea was much flattered by the proposal and at once accepted the king's offer. The wedding preparations were celebrated with great splendour. They included a musical festival in the theatre at which the poet Amoebeus was the chief performer. The king escorted Nicaea on the way to the theatre with many attendants about her richly decorated litter, but when the procession reached a forked road where one branch turned up to the citadel while the other led down to the theatre, he excused himself to Nicaea, ordering the escort to proceed to the festival where he would immediately follow. But as soon as the joyous crowd passed out of sight below the hill he hastened up to the gates of the fortress and demanded and received its possession. His triumph, however, was of brief duration, as the last great patriot of Greece, Aratus, soon came over from Sicyon, captured the stronghold, and then haranguing a vast concourse of people in the theatre successfully urged them to join the Achaean League.

As these incidents suggest, the theatre was situated close to the centre of the life of the city. It lies north-west of the market-place on the northern slope of a steep hillside with a broad outlook over the

Corinthian gulf towards Mt. Helicon, the snow-capped Parnassus, and other mountains of the north. Its site was located by means of trenches as long ago as 1896, but as it is buried deeply beneath from twenty-five to forty feet of earth its excavation did not seem to promise results commensurate with the labour and expense involved, and therefore was not undertaken until I began the work in 1925. In the past two years this excavation has been prosecuted on a large scale, and the results have been surprising and gratifying beyond all expectations.

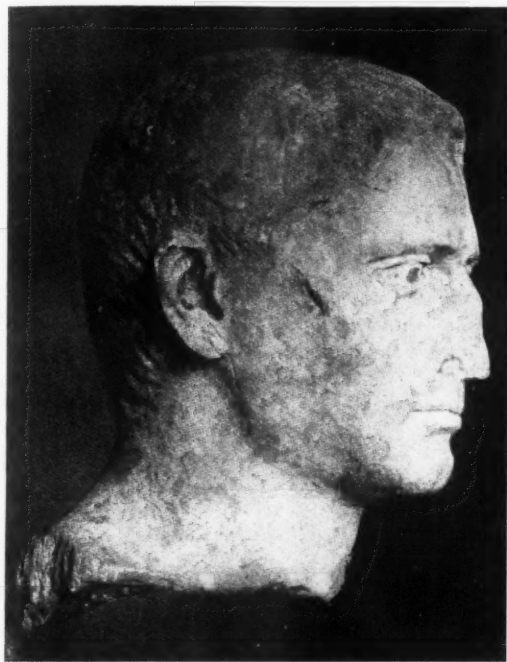
Near the close of the season of 1925 the floor of the orchestra was reached beneath forty feet of soil accumulation at its southern point opposite the centre of the stage building. It was found to be surrounded by a high circumference wall on which gladiatorial scenes are painted on stucco in bright colours. This wall was then uncovered for a distance of seven metres on either side of a central passageway that cuts it. During the latest campaign the wall was uncovered for its entire circuit, the orchestra was cleared, the auditorium was excavated for an average distance of thirty feet back from the circumference wall, both side entrances to the orchestra were uncovered, as was also the stage for its full width from east to west. Because of the depth of soil in this area this clearance necessitated the removal of 15,000 tons of earth, which was carried on dump-cars running on a narrow-gauge double-track railway five hundred metres to the north and there dumped over a cliff.

The wall with the paintings is nowhere preserved to a greater height than two metres, that is, about two-thirds of its original height, and the remaining



GREEK VERSUS AMAZON.

One of the well-preserved fragments of sculpture unearthed at Corinth, among which this popular theme in Greek art—the battle against the Amazons—is of frequent occurrence.



THE ROMAN EMPEROR GALBA.

This marble bust was discovered under the cement floor of the orchestra in the Corinth theatre and is identified by comparison with portraits on coins.

surface is badly injured by cracks and breaks in the stucco. Fortunately, however, enough is preserved to give a good impression of the original appearance of the whole. The central passageway through the wall leads into a small area from which a narrow stairway ascends to the auditorium. Similar passages on the east and on the west, spaced equally at seventeen metres from the centre, open into semi-circular chambers which may have served as guard-rooms. The chief figure of the games stands just to the east of the central passage. His official position is indicated by his costume, which includes a long purple cloak and high red boots. The red boots are specially significant as their use was restricted to the highest officers of the Roman state. They were part of the ceremonial costume of generals in their triumphal processions, and we are told that Julius Caesar delighted to wear them. From Caesar they were adopted by the Roman emperors and appear afterwards as an adjunct to the early official dress of the Popes in Rome. It is conjectured that these *calcei mullei*, so named from the red mullet, are represented on some marble statues of Roman emperors, but the only certain example of them, because of the preservation of the colour, is on the wall of the theatre of Corinth.

The officer is engaged in combat with a lion behind which is a man dressed in the short clothes of a gladiator of the arena. His flesh is painted a brownish-red colour to indicate the tanned skin of the athlete. White bands are fastened around the legs below the knees, and his sandals are bound with white thongs. Beyond him are several gladiators in various attitudes of violent action, the last of whom stands close to a large frame structure with fourteen broad bars that is placed on the edge of the sand of the arena and appears to represent the cage of the wild beasts. Another charging lion comes beyond the cage, and then the cut in the wall for the east chamber is reached. This chamber is contemporaneous with the wall-painting, for the outer border of red and blue bands here makes a turn to form the vertical terminus of the frieze. On the continuation of the wall beyond the chamber two novel and interesting scenes are depicted, including a bull-fight in which the bull, elaborately decorated with a broad green ribbon about the body and red discs on the side, has rushed on to the point of a spear that is held by a crouching gladiator.

The wall on the west of the central passage has suffered more serious damage than on the east, but here another acrobatic scene is partly preserved. An athlete with his head tossed back, facing front, is standing on his hands in the arena, apparently about to make a handspring over the back of a charging lion. Beneath this lion a Greek inscription was discovered cut in the stucco. It says that the lion recognizes the fallen man as his saviour and licks his hands.

#### The Story of Androcles.

This recalls the story of Androcles and the Lion, and I think that it may, in fact, refer to that event. This story has been preserved to us in the words of an eye-witness of the scene, who was no less a person than the Greek, Apion, the greatest grammarian and most famous Homeric scholar of his age, the time of the Emperor Tiberius. Subsequently, when Caligula was emperor, Apion made a triumphal tour of the cities of Greece, where he was received with enthusiasm and adopted as a citizen because of his Homeric studies. It requires little imagination to picture his reception in Corinth where the host of slaves would have been less interested in his Homeric scholarship than in his tale of the experiences of the Greek slave in the Circus Maximus in Rome. The inscription on the painted wall dates from the time of the visit of Apion and may be reasonably interpreted as referring to the story of Androcles.

Thus, in spite of its badly damaged condition, this wall presents gladiatorial and acrobatic scenes of unusual interest depicted in brilliant colours, so that we are furnished important information of the impressiveness of decorative painting on a large scale at the beginning of the Christian era, and we learn of a hitherto unknown method of decorating an ancient theatre. The wall also offers confirmation of historical records, for the Roman colonists not only brought with them their home pottery, but continued to cherish and indulge their taste for gladiatorial exhibitions, in contrast to the literary and gymnastic games celebrated by the other Greek cities at their recurrent festivals. This practice persisted at Corinth in spite of the complete Hellenization of that city, and in the fourth century A.D. the Emperor Julian bitterly reproaches the Corinthians for spending great sums of money for the purchase of bears and leopards for the arena instead of patronizing the famous games of Greece.

#### Roman Weight Discovered.

In the great mass of earth lying above the orchestra many small objects of varying importance were scattered, among which were hundreds of bronze coins of the Roman and Byzantine periods. Among the minor objects from this area an oblong marble weight is important because it is marked with the symbol of its value. This symbol, "H-S," indicates the weight as 8 minae or 800 drachmas, and thus gives us the exact weight of the Attic-Roman mina, which previously had been approximately calculated from many scattered heterogeneous sources.

The floor of the orchestra as finally revealed was made of cement. But it had been originally covered with thin slabs of marble, some of which are still in place in the north-west and north-east ends. Scattered over this floor were Roman coins of the end of the fourth century A.D. As nothing of a later date appeared in this area we know that the theatre was not rebuilt after the destruction of Corinth by Alaric, the Goth, in A.D. 396.

A handsome round marble altar was lying on its side near the centre of the orchestra. This is elaborately decorated with a leaf moulding at the bottom, and on the sides with bulls' heads, from the horns of which are suspended heavy loops of interwreathed branches of fruits and flowers. We decided to set up this altar in the exact centre of the orchestra, but in order to avoid unnecessary handling of the heavy object a cut was made there in the cement floor to ascertain the condition of the underlying deposit before the altar was placed in position. This

trial disclosed a marble bust of a Roman that was buried just below the present floor. It is a portrait study of characteristic Roman type, with aquiline nose, clean-shaven face, firmly closed lips, and close-cropped hair. Its identification as a portrait of the Emperor Galba is assured by comparison of it with the representation of the head of Galba on Roman coins, especially coins of Corinth. The resemblance to one type of bust on the coins is so close that it is possible that the figure on the coins was actually taken from this very marble. Galba had a brief reign in A.D. 68-69, after the death of Nero, and at this time the bust must have been dedicated. It may have been thrown down by the great earthquake that occurred in the succeeding reign of Vespasian, A.D. 70-79, and was later buried under a new floor that was probably laid in the second century when the Emperor Hadrian and Herodes Atticus were erecting buildings in Corinth. This theory is supported by a hoard of bronze coins that was found beneath this level, some of which are coins of Hadrian. They may have been lost by one of the workmen engaged on the new construction. An earlier Roman floor-level occurs about nine inches below the present floor, and at a still greater depth is the stone pavement of the Greek orchestra. This is surrounded by an open water-channel that is crossed by stone bridges at intervals to correspond with the stairways in the auditorium, so that the spectators could easily pass from their seats through the orchestra to the exits. The nature of the construction of this channel enables us to date the Greek orchestra in the middle of the fourth century B.C.

#### A Relic of Caesar.

Only a few fragmentary inscriptions were found in the theatre, but one of them is interesting as evidence for the foundation of the great medical school at Corinth, and another has the name of Julius Caesar carved in beautiful letters. The resettlement of Corinth after it had lain desolate for one hundred years was, no doubt, induced by economic motives, but the immediate cause of the colonization seems to have been Caesar's superstitious nature. For one night on the African campaign his tent was pitched near the ruins of Carthage, which had been destroyed by Scipio in the same year in which Mummius had destroyed Corinth. All night long he was haunted by the ghosts of the women and children who had perished in the destruction of the city, and in the morning he realized that he would have no peace of mind until he had made restitution by the resettlement of both cities.



## Among the Stars: A Monthly Commentary.

### THE HEAVENS IN JUNE.

By J. A. Lloyd, F.R.A.S.

THE chart herewith is intended to show the aspect of the principal star-groups as seen from London on 1st June at 10 p.m. and on the 30th at 8 p.m. Planets visible this month will be as follows: Mercury, which will be a naked eye object in the twilight sky during the second and third weeks of the



month. It will be at greatest elongation east of the sun on the 22nd, and should be looked for in a north-west by west direction. Venus and Mars are very close together, in Gemini, early in June. They will be in conjunction on the 9th, Mars being the lower of the two. Jupiter is a morning star, rising soon after 1 a.m. during the first part of the month. It will be seen practically due east at rising. Saturn is nearly due south at 11.30 p.m. on the 1st of the month. The time used above is Greenwich mean time, not summer time.

#### The Surface of the Moon.

Although the moon is the nearest celestial body to the earth, and in consequence has been studied more minutely than any other, yet its surface presents many problems which still await solution. The origin of those characteristic "crater" formations which abound on the moon has puzzled astronomers ever since the telescope was first directed to them in 1610. That they are of volcanic origin is the view that has most commonly been held. Nasmyth, who worked out this idea in detail, in the last century, imagined them to have been formed by lava and ashes blowing out radially from a central orifice, and so building up a circular rampart. While this might possibly account for the smaller craters, the large ring-plains of one hundred miles diameter and upwards present a formidable difficulty. It has also been suggested that the lunar craters were formed by the explosive impact of huge meteorites falling

on to the hard surface of the moon from space. Much the same effect has been produced experimentally by hurling clay balls into soft clay, but the vast scale of the lunar formations would render the theory quite untenable in the case of a plastic surface. Recently yet another theory has been put forward which its author considers would account for these circular walled plains of the moon in a very simple fashion.

The propounder, Mr. H. Tomkins, F.R.A.S., brought forward his theory at a recent meeting of the British Astronomical Association. Briefly, the theory starts with a mound or hump in the lunar crust, caused by an upheaval of fluid lava from below. If the thrust were sufficiently violent and prolonged, the summit of the mound would crack and its edges would fall in, being melted in the cauldron of boiling lava in the centre. As more of the edges fell in, so the extent of the ring-plain would enlarge, until at last the disturbance subsided or the lava on the floor solidified, leaving a ramparted plain with a level or slightly convex floor—a very common feature of the lunar ring-plains. The theory has been worked out in detail to cover practically all the observed features of the moon's surface and, in the opinion of some astronomers, is a distinct advance on anything that has been put forward previously.

#### Return of a Comet.

Astronomers are eagerly awaiting the return of comet Pons-Winnecke which comes to perihelion, that is to say, approaches closest to the sun, in June. The comet was detected at the Yerkes Observatory by Prof. van Biesbrock on 3rd March but Mr. Gerald Merton has identified it on a photograph taken at Greenwich even earlier, on 25th February. While the comet will hardly be such a striking object as some notices in the daily press would have us believe, it will almost certainly be an easy object in quite a small telescope. It will be at its nearest to the earth on 27th June, when it will be about three and a half million miles away.

#### The Total Eclipse.

The event of the month is, of course, the total eclipse of the sun which will occur on 29th June. This is the first occasion on which a total eclipse has been observable in England since 1724. Particulars are being published in the newspapers in increasing quantity as the date approaches, but readers who intend travelling north for the occasion would do well to study in advance an authoritative description such as that published in *Discovery* last month by Dr. J. A. Carroll. In order that this article may reach the widest circle, it has now been issued as a reprint (price 6d., post free from the publishers) under the title "How and Where to Observe the Total Eclipse." To summarize a few of the points dealt with, it may be mentioned that a departure from the region of totality sufficiently great to allow less than one per cent of the sun to remain un eclipsed is enough to prevent any possibility of seeing the corona and prominences, owing to the intense and overpowering flood of light which is poured forth by even the smallest portion of the sun's surface. A suitable station for viewing the eclipse must therefore be carefully selected in advance. It is also pointed out that the event always brings a rush of patients to the oculists. In this connexion a number of inquiries have been received from readers since the publication of the article, and Dr. Carroll has accordingly now added for inclusion in the pamphlet a few lines amplifying the precautions originally suggested.

## The Month's Wireless Developments.

### ATMOSPHERIC PROBLEMS.

THE influence of atmospheric conditions on wireless was recently emphasized in the case of the new Transatlantic service, when on the opening day it was found impossible to complete all the calls that had been booked, owing to this factor. As might be expected, therefore, the problem is now the subject of extensive research, some of which has been made public in a report presented to the Royal Meteorological Society by a committee appointed under Mr. R. A. Watson Watt. This deals with the distances over which an atmospheric may produce disturbance of broadcast reception. The committee organized experiments in which observers in the British Isles, Norway, Germany, France, Spain, Morocco, and Madeira recorded disturbance of broadcast talks, while the sources of the atmospherics were identified through wireless position-finding, by an organization set up by the Department of Scientific and Industrial Research on the advice of its Radio Research Board.

Many of the sources were found to lie in regions of meteorological disturbance, and a subsequent report on these meteorological relations is promised. Meanwhile examples are cited of cases in which atmospherics from beyond the Azores disturbed the reception of Daventry's signals in Paris and of London's signals in Aberdeen, and of the disturbance of reception in Spain, France, Madeira, the British Isles and Norway by atmospherics from a thunderstorm at Rome. The committee concludes that very many atmospherics are heard at distances exceeding 1,800 miles from their sources, and that the distances may reach at least 4,500 miles, but they find no evidence of the presence of many atmospherics with a short range of disturbing effect.

### The Australian Beam Service.

Another example of interference with smooth working is afforded in connexion with the beam service recently inaugurated between England and Australia. During one portion of the twenty-four hours the beam is directed to and from England by the north-west route from Australia, while during the other it is sent in the opposite direction by the south-east route from Australia. At each change of route there is a period when communication is uncertain, though it is found that as soon as the change-over settles down high-speed working proceeds in both directions. Fortunately these uncertain periods at present occur, by Australian time, between 9 p.m. and midnight, and between 9 a.m. and noon; that is, during the time when practically all businesses are closed at one end or other. The change-over period apparently shifts during different seasons of the year, but observations have shown that good communication at high speed will be available during the heavy traffic hours.

The waves carrying the messages cover the distance in approximately one eighteenth of a second; and, as the service operates from England to Australia and vice versa simultaneously, it provides at certain periods of the day instantaneous communication in both directions between the heart of the empire and Australia. In addition to being the first direct service between the two countries, it constitutes the longest direct telegraph service in the world. Secrecy of communication is assured by the fact that all messages are transmitted and received by high-speed automatic apparatus,

the speed of operation in each direction ranging from 500 to 2,000 letters per minute. Taking the circuit as a whole its working speed, therefore, is from 1,000 to 4,000 letters per minute; and with the exception of other beam services, the speed of working is higher than that of any other long distance telegraph service in the world, whether by wire, cable or super wireless stations.

### A New Aerodrome Station.

Among the developments now in hand for the reorganization of the London air port at Croydon is the provision of a new wireless station, which is to replace the one that has done duty there for the last seven years. When this station is complete Croydon will possess greatly improved equipment, which will considerably extend its range of communication both with other terminal aerodromes and with machines in flight. The new station will consist of a group of four 3-kilowatt wireless transmitters, operated in conjunction with a wireless direction-finding receiver. The transmitters will be capable of telephonic and telegraphic transmission, the wave range being from 800 to 2,000 metres. Independent drive circuits will be incorporated to maintain constant frequency and wave-length, while energy for the transmitters is to be supplied by a common motor-alternator group, the power from which may be switched on to any of the transmitters. The wireless direction-finding receiver for Croydon has been specially designed and incorporates the latest filtering and amplifying devices. It is arranged so that, if required, two or more circuits can be operated on different wave-lengths for the reception of telephony and telegraphy on the same aerials.

In order to keep the neighbourhood of the aerodrome as free as possible from obstruction, the wireless masts and transmitters will be erected two or three miles from the air port and operated by the "remote control" system. It is expected that the reorganization of Croydon Aerodrome will be completed before the end of the season. Like the one it will replace the new wireless station is being built for the Air Ministry by the Marconi Co., the present one having been installed when Croydon first became the chief aerodrome of British civil aviation.

### Foreign Extensions.

A considerable extension of Japanese broadcasting is indicated by an order which has been placed with this same British company by the Japanese Broadcasting Association for three broadcasting transmitters for Japan. These transmitters are to be designed to give 10 kilowatts of aerial energy. It is understood that one is to be placed in the Japanese capital, Tokio, and another in Osaka, the largest city in the country, but the situation of the third station has not yet been indicated. Tokio will be the twelfth capital of the world in which a Marconi broadcasting station has been installed.

The new series of articles which the Manchester Station Director of the B.B.C., Mr. Edward Liveing, commenced in the May issue of *Discovery*, will be resumed on this page next month. Under the title "Broadcasting: A New Social Force," the relation of wireless to education, the drama and other such matters will be discussed; written from a semi-official point of view, the series should afford a unique survey.

## Book Reviews.

*Studies on the Origin of Cultivated Plants.*—*Bulletin of Applied Botany and Plant Breeding*, No. 16. In Russian and English. 1926. (Bureau of Applied Botany, Leningrad).

REVIEWED BY PROFESSOR B. P. UVAROV.

In view of recent discussions on the origin of cultivated plants and of agriculture, it seems both useful and interesting to direct attention of naturalists and of students of history of culture to the recently published remarkable work on the subject by Prof. N. I. Vavilov, director of the State Institute of Experimental Agronomy in Petrograd.

The work is based on extensive field-research carried on mainly in various parts of Asia, in the Mediterranean region, and in northern Africa, while a great amount of evidence has been collected also from nearly all other parts of the world. Careful morphological analyses, mass breeding, hybridization, and systematic studies of forms and varieties enabled the author to throw much light on the problem of main centres of origin of cultivated plants. The work is still very far from being completed—if, indeed, it ever can be—but five principal centres of origin of the majority of most important field, vegetable and orchard crops may be already located, as follows:—

(1) *South-western Asia*, including India, southern Afghanistan, mountains of Bokhara, Kashmir, Persia, Asia Minor, Transcaucasia. This centre has given rise to the soft and clubbed varieties of wheat, rye, small-seeded flax, small-seeded peas, lentils, horse-beans, chick-peas, Asiatic cotton (*Gossypium herbaceum*, *G. arboreum*), and several kinds of vegetables.

(2) *South-eastern Asia*, including mountainous parts of China, Japan, Nepal and adjoining regions. Here the forms of naked oats originated, as well as hull-less barley, millet, soya bean, many cultivated cruciferae, and many kinds of fruit trees.

(3) *Mediterranean centre*, includes northern Africa, Palestine, Syria, Greece with the islands, Spain, Italy, and southern parts of Asia Minor. Here are centres of origin of wheat of the *durum* group, of many kinds of oats, large-seeded flax, large-seeded peas, horse-beans, lentils, beetroot, many vegetables and fruit trees.

(4) *Abyssinia* and adjoining mountainous districts must be regarded as a special centre, since here an extraordinary variety of cultivated plants may be observed. The Abyssinian centre is characterized by diversity of forms of hulled barley, violet-grained wheat, peculiar races of peas and oats, as well as by a series of plants which are cultivated only here. This centre is being studied at present specially by Prof. Vavilov, who is on an expedition to Abyssinia for several months.

(5). In the New World, as far as the available material goes, *Mexico* and *Peru* with the adjoining mountainous countries must be regarded as a centre of origin of cultivated plants. Here various forms of potatoes, Jerusalem artichoke, certain varieties of beans, tobacco, sunflower, and American cotton originated, while there is also a large number of truly endemic cultivated plants.

(6). Finally, a sixth centre may possibly be seen in the *Philippines* and adjoining islands, where specially rice must have originated, but the data are not sufficient.

Further investigations will probably result in finding a series of secondary centres, as well as in a better definition of the centres already established. At the same time, however, it must be borne in mind that many plants, like hemp or rye, have been introduced into cultivation in different countries

simultaneously. Summing up, the principal centres of origin of cultivated plants are concentrated in the mountainous regions of Asia, of northern and north-eastern Africa, of southern Europe and, in the New World, in the Rocky Mountains and Cordilleras.

The mountainous regions bordering on the deserts of Central Asia, or on the Sahara in Africa, represent, owing to their diversity of climates and soils, the best possible conditions for the process of development of new varietal forms. The diversity of conditions, ranging from desert to rich oases, from soils devoid of humus to the rich soils of the subalpine and alpine zones, must be extremely favourable for production of variations of plants. At the same time, there was there always an abundance of water for irrigation, while in the higher altitudes the cultivation is possible without it, and these are factors which favoured the development of primeval agriculture in these regions.

Of the whole surface of the globe, the mountainous regions of Asia contain the bulk of human population, over one half of the whole humanity being concentrated in these regions, occupying only about one-twentieth of the whole land surface. When travelling through south-western Asia one is surprised by the extremely intensive utilization of every square foot of arable land. If the barren, arid and waterless tracts are left out of consideration, and the density of population is calculated on the base of arable land, the figures obtained exceed by far those for the most densely-populated districts of Europe.

When locating the centres of origin of cultivated plants some indications as to the centres of origin of human culture are obtained. The problem, whether the culture of Egypt was entirely independent, or it was borrowed from Mesopotamia, or vice versa, may be settled by the study of cultivated plants. The plants and their cultivated varieties are not so easily transplanted from one region to another, and the presence in northern Africa or in south-western Asia of numerous endemic species and varieties of cultivated plants are an evidence of greatest historical value.

The history of the origin of human culture (and of agriculture as one of its branches) is evidently much more ancient than preserved in such records as pyramids, inscriptions, burials, etc., and the study of varieties of cultivated plants enables us to go much further back. Smith and Perry in a recent work entitled "Evolution in the Light of Modern Knowledge" (Blackie & Son), have given a map, based on archaeological, anthropological and historical data, and indicating the principal centre of human culture in the region embracing Egypt, Italy, Balkan Peninsula, Asia Minor, Arabia, Mesopotamia, Persia, Afghanistan, Turkestan, Caucasus, and the ancient Scythia. The botanical evidence briefly discussed above enables us to add also India, mountainous China, Mexico and Peru. The newest archaeological discoveries in Punjab, Sind and China support this view.

*Pheasant Jungles.* By WILLIAM BEEBE. (G. P. Putnam's Sons. 12s. 6d.).

REVIEWED BY SIR ARTHUR SHIPLEY.

In search of pheasants Mr. Beebe of the New York Zoological Society travelled in South-east Asia for some eighteen months collecting material for his monograph. He traversed a route which is more familiar, perhaps, to our countrymen than to his. He seems to have had a bad time on the mail-boat between Brindisi and Port Said, but he recovered sufficiently to enjoy the Pyramids and to pass on to Ceylon. From Ceylon he went

to Sikim, Garhwal, Burma, Tibet, Yunnan, Pahang and Borneo. Much of this route is frequently travelled by botanical collectors seeking orchids and rhododendra and by British Government officials, and it is far more familiar to them than it is to the average American. However, Mr. Beebe has a very acute eye and a very facile pen, and he has managed to make a thoroughly readable book, illustrated by many of his own photographs. As it is impossible to deal with all the numerous creatures he met with on his trip, one may be permitted to say a word about the Pangolin, or scaly ant-eater.

This curious edentate occurs throughout Asia and parts of Africa. Some of the larger of these reach a total length of six feet. They are a very isolated animal with no near allies, and recently a special order, the *Pholidota*, has been invented for their reception. Their body is covered with separate scales like a pine cone. They turn out at the dusk of the evening, unroll their rolled-up bodies, and timidly step into the outer air. All they require is a populous ant-hill and a burrow into which to return when sated. The tail muscles are extraordinarily strong. The animal will often hang by its hind legs to a pole, stretching the whole of its body into space. According to Mr. Beebe the scales, which are well known to insert themselves in every crack or cranny should you attempt to move the animal, snap down like the jaws of a steel trap, and they will actually pinch off pieces of flesh. Their strong claws will tear through the ant-hills as hard as concrete. On the ground the animal is rather unhandy, walking about slowly on the outer side of its claws like a sloth.

There is much of interest in the volume, but we confess we were a little astonished at the calm way in which our author shoots a Kachin who was said to have attacked his camp with poisoned arrows. The whole incident is recorded with the matter-of-factness and objectivity of one of the author's compatriot gunmen.

*An Outline of Abnormal Psychology.* By WILLIAM McDUGAL, M.B., F.R.S., (Methuen. 15s.).

It is a good many years since Professor McDougal gave the general public "An Outline of Normal Psychology," and now he offers to the same public "An Outline of Abnormal Psychology." Since the publication of the first book Professor McDougal has become widely known, through his "Introduction to Social Psychology," as the exponent of human mental activity in terms of instincts, so that a very large circle of readers will turn with interest to see what light the author's system of psychology, so attractive in its simplicity, can throw upon the obscurities of mental disorder, and what practical application it may have. Many will also look to Professor McDougal's authority for a guiding criticism of the new schools of psychology which have been born out of the intensive study of disordered mental function.

With regard to the Freudian school, while the author gives full measure of appreciation to the application of Freud's theories, he nevertheless ranges himself, both in theory and practice, with that large and growing school of psychologists, represented by the late Dr. Rivers in England and by Dr. Morton Prince in America, who "have seen that Freud's teaching contains truths of importance alongside many errors and therefore have never given general adhesion to his views, but have sought to incorporate such truths in the general body of psychological science, rather than to follow Freud in setting up a new and esoteric doctrine."

Professor McDougal is more sympathetic towards the Freudian

schismatics, Jung and Adler. Jung, he feels, has "given psycho-analytic theory a turn in the right direction," but he preserves a strictly agnostic attitude towards his theory of ancestral influences. In Adler's theory of will to power as a dominant factor in mental life, and his theory of inferiority as a cause of neurosis, he sees a contribution to psychology whose value would be more generally recognized had it been more clearly expressed, and his long précis of Adler's theories will be very acceptable to those who have been baffled by the hopeless confusion of thought and language in which the original work is beclouded.

Since the purpose of the book is to explain to the general reader the relation between disorders of mental function (disorders due to disease of structure are excluded) and the normal working of the mind, it follows that exposition and criticism bulk very largely and, on first reading, the application of the author's own theories appears a little meagre. But the author's original contributions to an understanding of hypnosis and of that form of insanity known as *Dementia Praecox* stand out among others as especially valuable.

Suggestion and hypnosis, which are tabooed by the Freudian school with an almost religious abhorrence (that would be amply justified if their theory of them were quite irrefutable) are appreciated by Professor McDougal as valuable adjuncts in treatment. He sees in hypnosis and suggestion the active working of that instinct of submission which in the gregarious animals causes the individual to take his cue from one leader and ensures complete uniformity of action throughout the herd. It may be added that this theory seems to explain why the disciplined soldier is, rather unexpectedly, an excellent subject for hypnosis, and why certain types of neurotic who are "up against" the herd prove extremely resistant.

*Dementia Praecox* is illuminatingly explained as a morbid intensification of extreme shyness, in which the patient is paralysed by a conflict between the impulse to self-assertion and the impulse to submission, a condition comparable with the sulking of a shy child or the introverted brooding of a Malay who is about to run amok. It is noteworthy that this disorder, which is usually regarded as completely intractable, has begun to appear in a shade less hopeless light, for a few early cases are said to have yielded to psychological treatment, a brighter outlook that is encouraged by Professor McDougal's theory, and at least brings out the possibility of prevention by directing attention to the essential morbidity of extreme shyness and its treatability.

The book is written, as the author tells us, from the point of view, not of the specialist but of the student of human nature and it demonstrates, quite convincingly, that mental pathology is an exact science (the efflorescence of amateur literature on the subject may have given some excuse for doubting this), and it should leave the impression that there is something in that old definition of science as applied commonsense.

If the work has any shortcoming it is perhaps a slight tendency to narrowness in the choice of clinical material, the author having drawn very largely on his own practice, which lay almost exclusively among the cases of war neurosis. Although these are admirably suited, owing to their simplicity, for purposes of demonstration, yet one cannot help wondering, had his practice included more civilian cases, whether Professor McDougal would not have been more sympathetic towards certain theories of the analytical school; for example, that neurotic symptoms often represent an attempted solution of an unconscious conflict.

F. A. H.



*How Birds Live.* By E. M. NICHOLSON. (Williams & Norgate Ltd. 3s. 6d.).

The previously published works of this ornithologist of the newer school, in book form and in *Discovery*, characterized as they are by thoroughness and explicitness, and imbued with the scientific spirit, led us to commence the perusal of this one hundred and forty page volume with not a little expectancy. It may be said at once that we have not been disappointed.

Mr. Nicholson is a bird-lover as well as an ornithologist—a happy combination not always obtaining—and those who regard ornithology as a worn-out science, where everything is known already, will find in "How Birds Live" a source of lively disillusionment. Within recent years a numerous and inquisitive body of observers have been steadily bringing to light new facts and upsetting theories long taken for granted, "rendering untenable," as Mr. Nicholson says, "a great many beliefs which, in spite of that, appear still to be widely held, not only by the public, but by more than one well-known writer on birds." The author's original purpose was to give a digest of these discoveries, and to present a brief and simple account of the view of bird-life reached by modern observations. But the advance is taking place in isolated salients, not all along the line, and to have followed his first plan strictly would have meant passing over various gaps still to be filled, and giving fresh currency to theories with which he was unable to agree. "The book, therefore, is to be taken as the view of an observer who has studied the writings in question, and personally tested them in the field; not as a plain summary of the writings themselves."

Accepted theory has not been departed from without good and sufficient reasons. Mr. Nicholson is not afraid to hold his own opinions, and even if his arguments are not always convincing, the book is written in an exceptionally clear style and in a critical suggestive spirit, so that the reader instinctively feels he is under the safe guidance of a man imbued with the truly scientific habit of mind. In any case, the book may be commended to those who desire to gain some idea of the nature of the fascinating problems which ornithologists are seeking to solve. There are bird associations, just as there are plant associations, though the obstacles arising from their mobility have so far deterred ornithologists from their systematic investigations on a large scale. "How Birds Live" resolves itself into a strong plea for a study of bird ecology, which the author insists is indispensable to a proper knowledge of the economic value of birds in Britain. It will be seen that the author's scheme is comprehensive, and although the book is of very modest dimensions, we can only hint at the subjects which are treated within it.

His restatement and criticism of the territory theory is based on an intensive study of the bird population of a forty-acre estate during the whole of the breeding season, in the course of which every bird was enumerated—its offspring recorded, and its location mapped. A bird census, four times repeated (for details see *Discovery*, August, 1920), provided further data, and the treatment of bird-song, which he associates rightly with the territory theory, is the position reached after prolonged observation. In making himself responsible for the statement that "no first-rate authority has yet paid sufficient attention to bird-song," it may be suggested that Mr. Nicholson has overlooked Prof. Walter Garstang's "Songs of the Birds"; or does he cover himself by the use of the saving word "sufficient"? Prof. Garstang's introductory essay on avian

song is regarded by some, including the reviewer, as a contribution to the science of the subject which deserves serious consideration. His attempts to set down on paper representations of the songs of different species are also of interest, although opinions will probably differ as to whether he has greatly succeeded where others have failed.

Attention may be called to the several appendices, one of which, the fifth, gives some bibliographical notes valuable to the student who desires to pursue the subject further. One paragraph in this appendix calls for quotation: "For communicating the true spirit of the observer there is no book equal to 'The Natural History of Selborne,' for so far as it goes Gilbert White is almost as far in advance of our times as he was of his own." There is profound truth in this remark. White was not of the new school of natural history, yet he was of the newest. Never did he tear a flower to pieces and tell us exactly of what parts it was made. Yet, as a clear-eyed unviolent observer, the naturalist parson of Selborne parish had his triumphs quite commensurate with anything open to us in our time. From the sober and elusive willow-wren he sorted out the three species that we know to-day.

H. H. W.

*Edison, the Man and his Work.* By GEORGE S. BRYAN. (A. A. Knopf. 18s.).

Complaint is often made that genius suffers from a lack of recognition, and there is plenty of well-documented evidence in favour of this contention. It is not so generally realized, however, that genius may suffer from too much recognition, and, though it is not the object of Mr. Bryan's book to show the correctness of this theory, by giving a round unvarnished tale of Edison's achievements he does go at least some way in that direction. For to this American pioneer has been given at one time or another the credit, or discredit, of every possible invention, with the result that in scientific circles his work has been regarded as something below its face value. For more than one reason this is a pity, for whatever may be thought of the results he has obtained, there can be nothing but praise for the energy, persistence and ingenuity which was over and over again expended in arriving at them. Edison has done so much, however, that there is no need why inventions, which are not due to him, should be claimed as part of his work. This is a common failing among writers on this subject, and it is one of which even Mr. Bryan is not wholly free. There are quite a number of electrical devices in use to-day which Edison did not invent and with which indeed he had little or no connexion.

What Edison chiefly lacks is knowledge of mathematics. He is, of course, not the only pioneer of which this is true. And it would be interesting, if not altogether profitable, to speculate what might have happened if the experimental genius of Faraday had been combined in one man with the mathematical genius of Kelvin; or if in some way the particular direction of attack of Edison and Heaviside could have been brought under one control. It is evident from a study of Mr. Bryan's book that a good deal of time at least could have been saved.

It is too early yet to assign Edison his correct place in scientific history, but Mr. Bryan is to be congratulated on having written a book which will enable this to be done when the proper time comes.

F. H. MASTERS.

*The Civilization of the South American Indians.* By RAFAEL KARSTEN, Ph.D. "History of Civilization" Series. (Kegan Paul. 25s.).

While the archaeology of South America has been closely studied, thanks to the romantic accounts of the advanced civilization of the Incas which were recorded by the Spanish conquistadores, the culture of the modern Indian has not received comprehensive treatment as a whole. This is surprising, as it is by no means lacking in interest, for South America in its southern extremity is the home of some of the most primitive peoples still existing, and in its affinities in certain elements with the peoples of other parts of the world—witness the use of the blow-gun for which a parallel is found in South-eastern Asia—it presents some nice problems in the discussion of geographical distributions. Nor was the material for such a general survey lacking, for many of the tribes, for instance in British Guiana, in Brazil, and in the Argentine, have been the subject of intensive study. Professor Karsten has now stepped into the breach, and although the basis of his study was his own personal observation, starting from an inquiry into the origin and meaning of certain self-decorative practices, his comparative studies cover the whole of South America and have necessitated the full use of the material afforded by other writers. Further, although he began only with certain aesthetic or quasi-aesthetic impulses and the underlying religious ideas, it will come as a surprise to no one acquainted with the inevitable trend of anthropological investigation to find that he covers the whole of the field of social anthropology. The result, as Professor Westermarck indicates in his preface, is a work of first-rate importance to the ethnologist, and of absorbing interest to all who are attracted

by the study of primitive ideas as they are found among the more backward peoples.

E. N. FALLAIZE.

*Beyond the Milky Way.* By GEORGE ELLERY HALE. (Charles Scribner's Sons. 7s. 6d.).

Professor G. E. Hale is one of the most outstanding American astronomers. He has had a long and distinguished official connexion with the science, filling successively the posts of director of the Yerkes Observatory and the Mount Wilson Observatory. Further, he has been for over thirty years a tireless worker in the field of solar astronomy, and may without exaggeration be called the chief authority on the Sun.

Professor Hale is also known as a luminous writer on astronomy. Within the last few years two charming little books have appeared from his pen—"The New Heavens" and "The Depths of the Universe." Messrs. Charles Scribner's Sons have just published a companion volume to these, "Beyond the Milky Way," which takes its name from the third of the essays it comprises. The other two are entitled, "The Oriental Ancestry of the Telescope" and "Heat from the Stars." The first is a careful survey of pre-telescopic methods of observation and measurement, in which Professor Hale compresses a good deal of information not easily accessible to the general reader. The second deals with the recent radiometrical work on the heat of the stars. The third essay deals with the spiral nebulae as external galaxies, in the light of the recent work of Dr. Hubble. The book is elegantly produced and illustrated by beautiful photographs. No student of astronomy should neglect to provide himself with a copy of this volume.

HECTOR MACPHERSON.

## Books Received

*On Iodine.* By KENNETH FRASER, M.D., D.P.H. (De Gruyter & Co. Ltd.).

*The Age of Discovery.* By RHODA POWER. (G. P. Putnam's Sons. 2s. 6d.).

*Sir Francis Drake.* By J. D. UPCOTT. (G. P. Putnam's Sons). *Robert Clive.* By R. GATTY. (G. P. Putnam's Sons. 2s. 6d.).

*Queen Elizabeth.* By IRENE L. PLUNKET. (G. P. Putnam's Sons. 2s. 6d.).

*The Quantitative Method in Biology.* By MACLEOD. (Longmans, Green & Co. Ltd. 15s.).

*How Birds Live.* By E. M. NICHOLSON. (Williams & Norgate. 3s. 6d.).

*An Introduction to Anthropology.* By WILSON D. WALLIS. (Harper & Brothers. 16s.).

*Science and Human Progress.* By SIR OLIVER LODGE. (Allen & Unwin Ltd. 4s. 6d.).

*Electrical Horology.* By LANGMAN and BALL. (Crosby, Lockwood & Son. 7s. 6d.).

*The British Museum Quarterly.* No. 4. (Trustees of the British Museum. 2s.).

*The Geography of Witchcraft.* By MONTAGUE SUMMERS. (Kegan Paul. 21s.).

*Rusticus, or the Future of the Countryside.* By MARTIN S. BRIGGS. (Kegan Paul. 2s. 6d.).

*Astronomy.* Vol. I. By H. N. RUSSELL, R. S. DUGAN and J. Q. STEWART. (Ginn & Co. Ltd. 10s. 6d.).

*Guide to the Crustacea.* (Trustees of British Museum. 1s.).

*Mathematical Tables (Four Figures).* By C. V. DURELL, M.A. (G. Bell & Sons Ltd. 9d.).

*Across Arctic America.* By KNUD RASMUSSEN. (G. P. Putnam's Sons. 21s.).

*Lister Centenary Exhibition Handbook of the Wellcome Historical Medical Museum.* (The Wellcome Foundation Ltd.).

*The Wellcome Historical Medical Museum Handbook.* (The Wellcome Foundation Ltd.).

*Science: Leading and Misleading.* By COLONEL ARTHUR LYNCH. (John Murray. 7s. 6d.).

*Ancient Rome at Work.* By PAUL-LOUIS. (Kegan Paul. 16s.).

*Savage Life in the Black Sudan.* By C. W. DOMVILLE-FIFE. (Seeley, Service & Co. Ltd. 21s.).

*Stentor: Or the Press of To-day and To-morrow.* By DAVID OCKHAM. (Kegan Paul. 2s. 6d.).

*Trade Unionism and the Trade Union Bill.* By RAMSAY MUIR. (Williams & Norgate Ltd. 1s.).

*Report of the Stone Preservation Committee.* (H.M. Stationery Office. 1s. 3d.).

*Annals of Archaeology and Anthropology.* Vol. XIV. Nos. 1-2. (Hodder & Stoughton. 12s.).

*The Natural History of Ice and Snow.* By A. E. H. TUTTON. (Kegan Paul. 21s.).

*Picture Postcards, Sets H 4, H 5, H 6, H 7, H 8, H 9.* (British Museum (Natural History). 1s.).

*London Essays in Economics in Honour of Edwin Cannan.* Edited by PROF. T. E. GREGORY and DR. HUGH DALTON, M.P. (George Routledge & Sons Ltd. 10s. 6d.).

*The Revolt of Asia.* By UPTON CLOSE. (G. P. Putnam's Sons. 10s. 6d.).

*Spectroscopy.* By E. C. C. BALY, C.B.E., M.Sc., F.R.S. (Longmans, Green & Co. Ltd. 18s.).

*Photography: Its Principles and Practice.* By C. B. NEBLETTE. (Chapman & Hall. 30s.).

*The Polar Regions.* By R. N. RUDMOSE BROWN, D.Sc. (Methuen & Co. Ltd. 12s. 6d.).

*The Romance of Chemistry.* By WILLIAM FOSTER. (The Century Co., New York. \$3.).

*Travels in Spain and the East.* By SIR FRANCIS SACHEVERELL DARWIN. (Cambridge University Press. 6s.).

*The Foundations of Euclidean Geometry.* By H. G. FORDER. (Cambridge University Press. 25s.).

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